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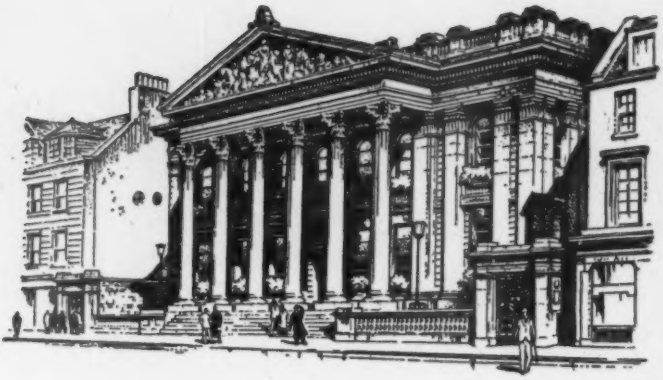

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THE SCOTTISH
GEOGRAPHICAL
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SOME PHYSICAL AND SOCIAL FACTORS IN THE EVOLUTION OF A MINING LANDSCAPE

A STUDY IN THE EASTERN AREA OF THE FIFE COALFIELD

R. GOODWIN

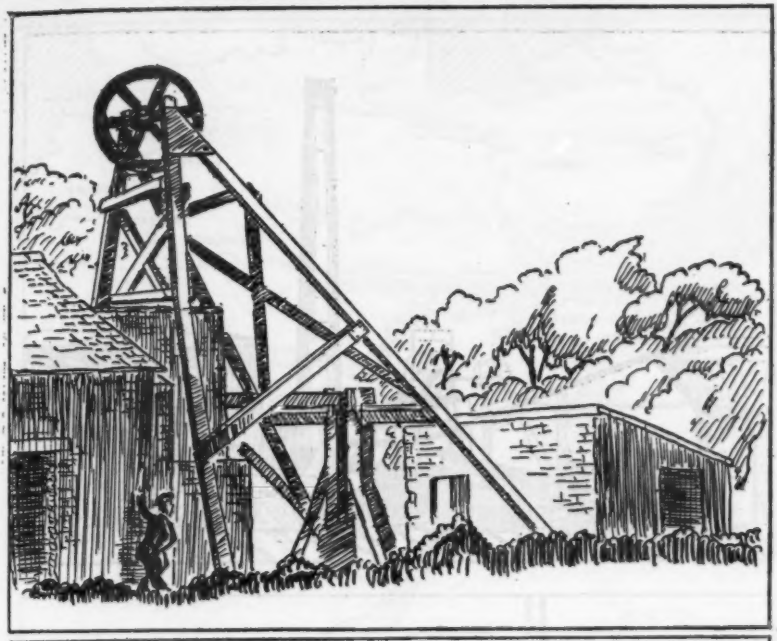
TO the regional geographer, concerned with visual evidence of the human response to environment, the most obvious indications of mining activities in a region are the 'head gears' and 'bings' rising above the surface of the land. Most familiar, are the surface features of the contemporary colliery-tall winding-gear in a tracery of steel girders supporting the ever-moving wheels; engine-house and smoke-stack; screening plant and maze of railway tracks (Fig. 5). These are sufficiently obtrusive to obviate any need for detailed field-study. But closer probing along the bye-ways, among woods, along old tracks and secluded coasts, brings to light certain 'mining antiquities'. These pointers to the past may amount to little more than a certain dark discolouration in the soil of a freshly-ploughed field, or low vegetation-covered mounds surrounded by cultivated fields, or the broken masonry forming the parapet of what appears to be a disused well (Fig. 1). These have no obvious associations with mining. More recognisable, yet still clearly 'dated' are the low timber head-gears, and stone towers housing the beam-engines, of an early industrial era (Figs 3 and 4). Exceptionally, the region may hold a pointer to the future in mining fashions, as far removed from the popular image of a 'pit', as are those remnants from the past — as shown in the clean lines and simple functionalism of the new Rothes Colliery at Thornton with its winding towers enclosed in glass and concrete (Fig. 6).

In these pit-head patterns, in their changing physical forms and spatial distribution over the centuries, is summed-up a region's mining history. It is a history of the miner's continual struggle against particular environmental difficulties, within a context of specific social conditions. In this struggle the pit-heads are seen as milestones marking the stages of technical advance.

The Eastern area of the Fife Coalfield, with which the present

Fig. 1 (above) Old Balbirnie Pit, sunk on to a day-level in the 1730's: near Dickson's mill, west of Markinch, Leven Valley.

Fig. 2 (below) Old "Sitts" or subsidence hollows in General's Plantation, South of Thornton: caused by subsidence above "stalls" worked in the Dysart main coal, here very near the surface.



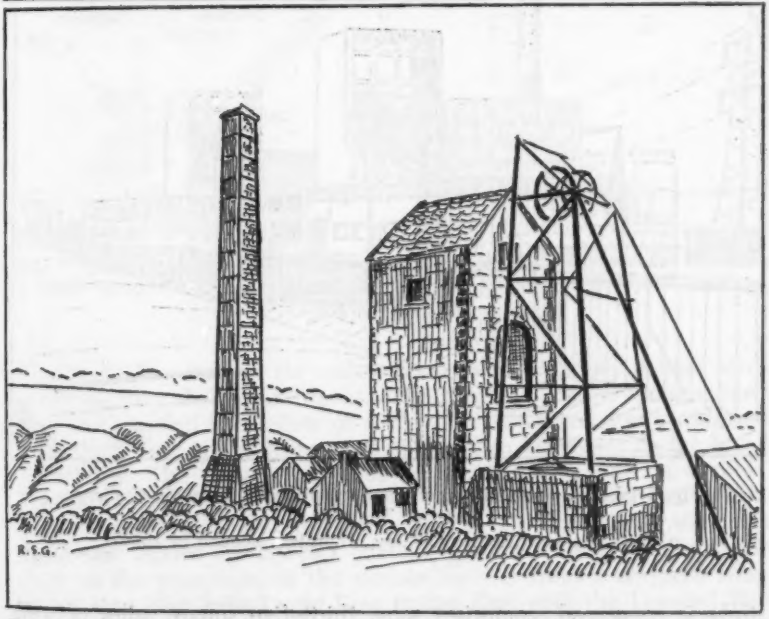
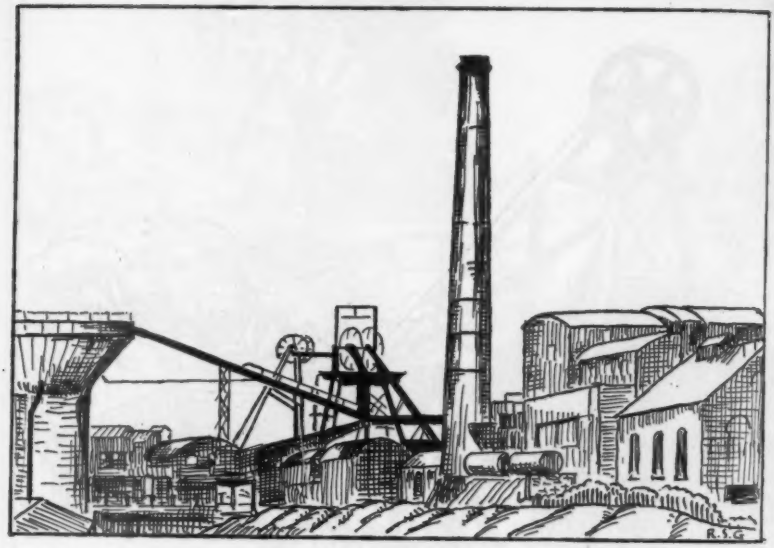


Fig. 3 (above) Balgonie Engine Pit, with early timber headgear, late eighteenth or very early nineteenth century : Leven Valley, west of Balgonie Castle.
Fig. 4 (below) An Engine Pit of the nineteenth century (1846) with beam-engine house : Lochtyside, near Thornton.



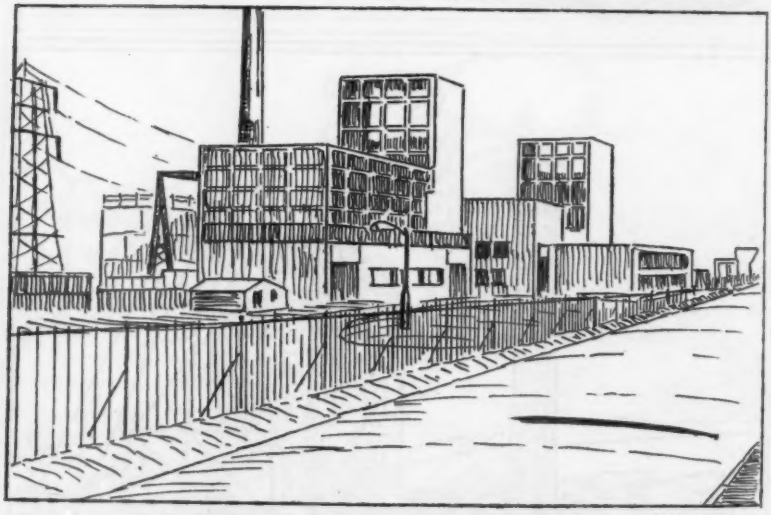


Fig. 5 (above) Late nineteenth-century pithead : Balgonie Colliery, east of Thornton.
Fig. 6 (below) Rothes Colliery, Thornton, opened in 1950's.

study is concerned, comprises some thirty-five square miles of well-farmed undulating lowland on the north side of the Firth of Forth (Fig. 7). Roughly triangular in area, its base is the ten miles of coastline between Kirkcaldy and Leven, while its apex reaches inland to beyond

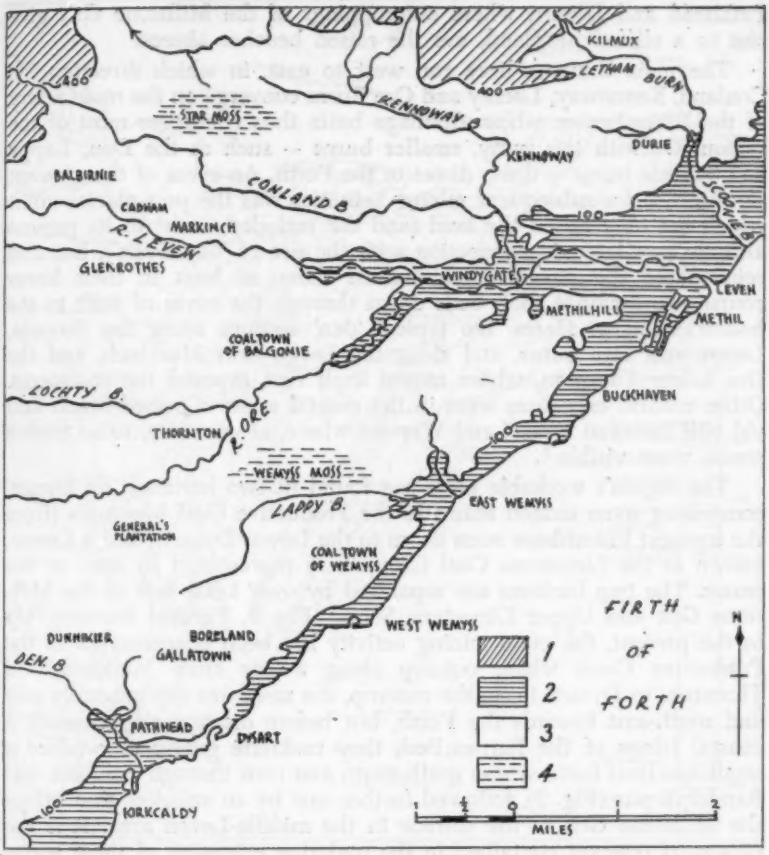


Fig. 7 Eastern area of Fife Coalfield: surface features 1. Land over 400 feet; 2. land under 100 feet — raised beaches and alluvial flats; 3. low plateau; 4. ill-drained flats.

Markinch. The bulk of its surface forms a low plateau planed across gently-dipping shales, sandstones, limestones and coals of Carboniferous age, and mantled by a cover of boulder-clay that averages in thickness from thirty feet in low-lying areas to less than eight feet on the higher interfluves. The region may thus be considered a part of Ogilvie's "lower Lowland peneplain". There is a general slope from an altitude of 400 feet in the north and north-west to 100 feet in the south and south-east. Above the 400-foot contour, gradients are generally steeper than on the peneplain, as the surface rises to form a northern fringe of hill-land that links Largo Law in the East with the Lomond Hills in the West. Below the 100-foot contour an abrupt break of slope marks the transition to raised beaches along the coast, and alluvial flats in the lower incised portion of the Leven Valley. Only between

Pathhead and Dysart, where outcroppings of the Millstone Grit give rise to a cliffed headland, are the raised beaches absent.

The main drainage-lines run west to east, in which direction the Conland, Kennoway, Lochty and Ore Burns converge on the main artery of the River Leven, whose drainage basin thus comprises most of the region. Outwith this unity, smaller burns – such as the Den, Lappy and Scoonie burns – drain direct to the Forth. An event of the greatest significance for subsequent mining activities was the post-glacial uplift which not only raised the land (and the included coals) to its present altitude (see later, in connection with the use of 'day-levels'), but also rejuvenated the streams and enabled them, at least in their lower courses, to excavate their beds down through the cover of drift to the bedrocks below. Hence the typical 'den' sections along the Scoonie, Lappy and Den burns, and along the Leven near Markinch, and the Ore below Thornton, where nature itself first exposed the coalseams. Other natural exposures were in the coastal areas of raised-beach and old cliff between Dysart and Wemyss where, at one time, some twelve seams were visible [1].

The region's workable coals are found in two horizons: an Upper, comprising some sixteen seams in the Productive Coal Measures (from the topmost Pilkembare seam down to the Lower Dysart); and a Lower, known as the Limestone Coal Group here represented by nine or ten seams. The two horizons are separated by over 1,800 feet of the Millstone Grit and Upper Limestone Series (Fig. 8, Vertical Section). Up to the present, the main mining activity has been concentrated in the Productive Coals which outcrop along a line from Markinch, via Thornton, to Dysart. From the outcrop, the measures dip generally east and south-east towards the Forth, but before disappearing beneath a coastal fringe of the Barren Red, they undulate gently to produce a small synclinal basin whose north-south axis runs through Balgonie and Randolph pits (Fig. 9), followed further east by an anticline that brings the Millstone Grit to the surface in the middle-Leven area. It is the enormous reserves contained in the undersea extension of these seams that ensure the region's future as Scotland's leading coalfield [2].

The lower coals (Limestone Coal Group) are found some 4,000 feet below sea-level in the East Wemyss area, but they rise westwards to form a crescentic outcrop that laps Kirkcaldy on its northern and north-eastern fringes. Odd inliers, consequent on faulting, appear in the north-west of the region (Balbirnie field) and the north-east (Kilmux). It is probable that much of the undersea extension of the lower coals lies too deep for winning with existing techniques, but most of the remaining reserves in the landward area will be exploited by the new Rothes sinking near Thornton. A dominant feature of the whole field is the multiplicity of faults. These are largely responsible for the enormous volume of ground water with which the miners have always had to contend.

The Six-Inch Geological Maps record upwards of 150 sinkings in this small coalfield in the course of its long mining history, but the visible evidence of their existence, apart from those currently working, is pitifully small. The reseacher must have recourse to a variety of

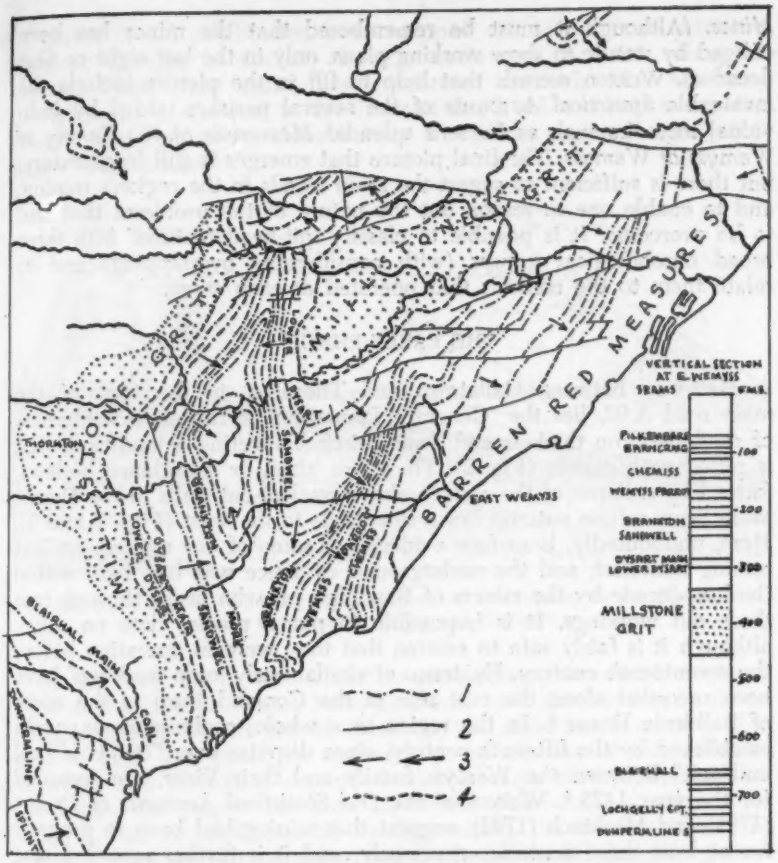


Fig. 8 Main Coal structures of the Eastern area of the fife Coalfield.
1. Outcrops of coal seams ; 2. main faults ; 3. dip of coal measures ; 4. boundary of exposed part.

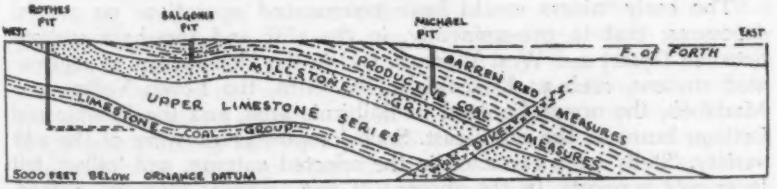


Fig. 9 Section from Thornton (Rothes Pit) to East Wemyss (Michael Pit).

sources to learn such vital details as the actual date of a given sinking and the period of its operational life. Some of the older Colliery Plans and private Estate Plans (such as those of Wemyss in the eighteenth century and Balbirnie and Balgonie in the nineteenth) are extremely useful, coupled with the official *Catalogue of Plans of Abandoned*

Mines. (Although it must be remembered that the miner has been obliged by statute to show working plans, only in the last eight or nine decades). Written records that help to fill in the picture include the invaluable *Statistical Accounts* of the several parishes, aided by individual memoirs such as Fraser's splendid *Memorials of the Family of Wemyss of Wemyss*. The final picture that emerges is still fragmentary; but there is sufficient to sugest the main trends in the region's mining, and to enable one to reason out the nature of the problems that had to be overcome. It is possible to classify 'pit-head features' into three broad chronological groups (with considerable overlapping) and to relate them to the controls that operated at each stage.

THE EARLY PHASE

Half-way between Gallatown and Thornton, to the west of the main road A.92, lies the 'General's Plantation', a fifty-acre wilderness of rhododendron thickets and dwarf birch blanketing a landscape that is pitted with craters (Fig. 2). These are 'sitts', or subsidence hollows, formed by collapse of the surface above worked-out stalls in the Dysart Main Seam whose outcrop lies a few yards to the west (Figs. 7 and 9). Here, undoubtedly, is surface evidence of some of our region's earliest mining activities; and the underground evidence was laid bare within the last decade by the miners of Randolph pit who broke through into these old workings. It is impossible to put a precise date on them, although it is fairly safe to assume that they were in operation before the seventeenth century. Evidence of similar early 'crop-workings' have been recorded along the east side of the Conland Burn to the north of Balbirnie House [3]. In the region as a whole, coalmining was well-established by the fifteenth century, since disputes over "teinds of coal and salt" between the Wemyss family and their Vicar, are recorded for the year 1475 [4]. Writers of the *Old Statistical Accounts* of Dysart (1791) and Markinch (1792), suggest that mining had been in progress for at least three centuries previously; and it is further recorded that a mining settlement – the "Coaltown" of Balgonie was mentioned as "one of the appurtenances" of the Balgonie Estate in a County Valuation of 1517.

The early miners would have commenced operations on natural exposures; that is, pre-eminently, in the cliff and foreshore sections between Dysart and West Wemyss, and in the 'den' sectors of rejuvenated streams, such as Kirkcaldy's Den Burn, the Leven Valley near Markinch, the upper Conland in Balbirnie area, and the Scoonie and Letham burns in the north-east. Such 'cropworkings' were of the adit variety. 'Stalls' were extracted in the selected outcrop, and 'pillars' left in as roof supports. In the absence of any artificial drainage method, the depth to which such workings could go was strictly limited by the height of the ground-water (Fig. 10). The miner could only work 'level free', *i.e.* in the zone above the water-table. In consequence, the early mining assumed an extensive rather than an intensive character. Having worked down the dip of the seam to the maximum depth permitted by the level of the water-table, the miner was then forced to extend his operations laterally *i.e.* along the crop of the seam. Fresh areas

of gravel or till overburden were stripped off, in a sort of primitive opencast fashion, to disclose the continuation of the seam along the surface. Then, once again, 'stoop-and-room' methods were advanced down the dip of the coal to the limits of the 'level-free' region working which, according to the older writers, was in the region of eighty feet below the surface [5].

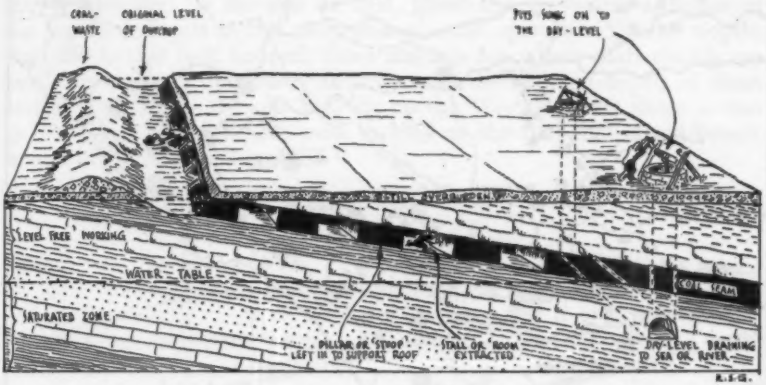


Fig. 10 Early modes of mining, as employed on the outcrop of the Dysart Main Seam between Thornton and Gallatown.

In this way, the pattern of certain main outcrops was early revealed. That of the historic Dysart Main Coal had been disclosed in its entire length between Dysart and Markinch by the seventeenth century. The area of coal that could be removed in the absence of any artificial drainage aids obviously depended on the angle of dip. The smaller the angle, the greater the area above the water-table that could be worked, but in addition, the further would the working faces be removed from the adit entrances, and the longer would the underground haul become. To obviate this, stone-lined pits were sunk at some distance from the outcrop, and the coals wound-up by manually-operated windlass, or carried up on the backs of the colliers' women-folk, using a series of ladders. (Hence the notorious "Stair Pits" that Hugh Miller describes in his *History of Tranent* and which frequently occured in this area.) (Fig. 11). Thus, in this earliest phase, the main surface features of the mining-landscape were a sprinkling of windlass-pits and stair-pits, subsidence hollows marking the excavated 'rooms' in the seams below, and lines of coal-waste along known outcrops, the fore-runners of the huge bings that typify the modern mining scene. At one time, the writer of the Dysart Account informs us, one such "continuous line of waste was visible for three miles along the crop" (of the Dysart Main Seam).

The era of 'sinkings' proper, as distinct from adits, seems to have been ushered in along with earliest attempt at a measure of artificial drainage. This was the method of the 'day-level', which was simply a tunnel driven at a gently rising gradient from the edge of some convenient water-area such as sea or river, up into the underside of the

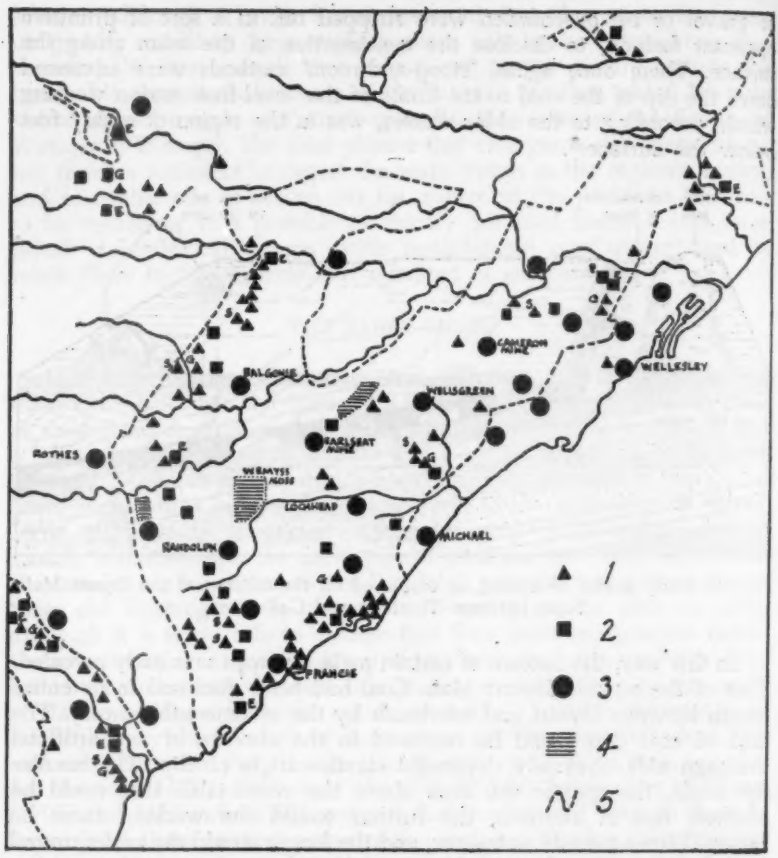


Fig. 11 The changing pattern of pit distribution in the Eastern area of the Fife Coalfield.

1. Pits of early phase-operating before late-eighteenth century: S = known 'stair' pits : G = known 'gin' pits (probably horse-gins).
2. Pits of the transitional phase-operating between late - eighteenth and early-nineteenth century : E = known engine pits.
3. Pits of the modern phase - Sunk during or since late - nineteenth century : those named still (1958) working.
4. Open-cast sites worked since 1940 : Wemyss Moss site still (1958) working.
5. Boundaries of exposed coalfield.

coals, thus draining all the strata that lay above. (Figs 10 and 12). The rejuvenated topography of the region was ideally suited to such a technique since, the greater the degree of post-glacial uplift and of valley-incision, the greater was the amount of land and included coal-seams above local base-level and thus the greater volume of coal that could be drained by this simple device. One such level was driven in 1730 by Balfour of Balbirnie, from the north bank of the Leven, and it continued to drain his seams for the next forty years, which suggests

that the range of mining operations was considerably extended. Another level, in the Kilmux field, over 2,000 feet long, drained into the Letham burn [6]. Still others emerged on the coast at Kirkcaldy, Dysart and West Wemyss harbours. The practice was to sink pits on to the levels, which would thus assume markedly linear patterns on the surface.

Despite the extension of mining, both vertically and laterally, made possible by the use of day-levels, the lowest ultimate base-level was that represented by the sea; so that, given the prevailing altitudes of our region, few pits in this early phase, could operate at greater depths than 250 to 300 feet. Indeed, those sinkings for which shaft details are available, suggest that thirty fathoms was the average depth of these earlier pits. One – the old Mill Pit on the West Wemyss shore – was as shallow as nine fathoms; sunk in 1654 on the fifty-foot raised beach, it was "drowned-out" in 1657 [7].

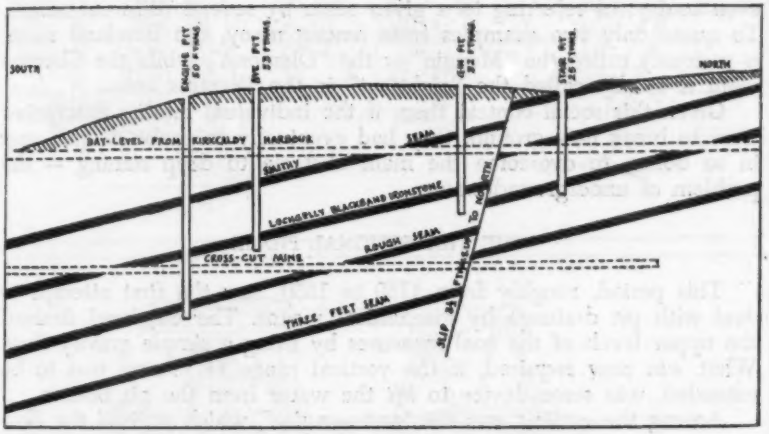


Fig. 12 Sketch-section showing Kirkcaldy pits in 1818. Afer a section drawn through Kirkcaldy Colliery in 1818, by Robert Bald, mining engineer of Alloa : now in possession of N.C.B., Dysart, Fife.

An interpretation of the map showing pit distributions at various periods (Fig. 11) reveals that the earliest known sinkings fall into several distrinct groupings of closely-spaced pits: –

(a) Those that parallel the outcrops of a few early-known seams such as the Dysart Main Coal (Balgonie and Dysart areas) and the Blairhall Main Coal (near Kirkcaldy).

(b) Coastal groupings, such as those near West Wemyss, Dysart and Kirkcaldy Harbours.

(c) River-valley groupings – such as those on the Leven and Conland burns (Balbirnie Field), the Scoonie Burn (Durie Field) and the Letham Burn (Kilmux Field).

The use of human porterage, by limiting the length of underground haulage-ways, helps to explain the close spacing of pits within each group. The localisation of early mining, while reflecting in the main the restricting influence of the early drainage techniques discussed

above, was also, in part, the outcome of certain social factors. The whole coalfield was divided into separate mineral estates worked, either by the lairds, or by 'tacksmen'. Each was restricted to the seams within his area, and the Wemyss family correspondence leaves no doubt that the intense rivalry between the different lairds led to their conducting their separate mining operations in an atmosphere of downright secrecy. It is tempting to suggest that this attitude helped to perpetuate the system of colliery serfdom and the isolation of miners in separate colliery villages, of which, five already existed in this area by the end of the eighteenth century: – the 'Coaltowns' of Balgonie, Wemyss and Methil (now Methilhill), and the villages of Cadham and Boreland. One thing is certain; there was no possibility at this early stage of attempting a planned exploitation of the field as a whole, and individual lairds were frequently ignorant of the continuation of their own seams into a neighbouring area. This is reflected in the practice, current even to-day, of referring to a given seam by several different names. To quote only two examples from among many, the Boreland seam, is variously called the "Mangie" or the "Diamond", while the Chemiss seam is locally called the "eightfoot" in the Wemyss area.

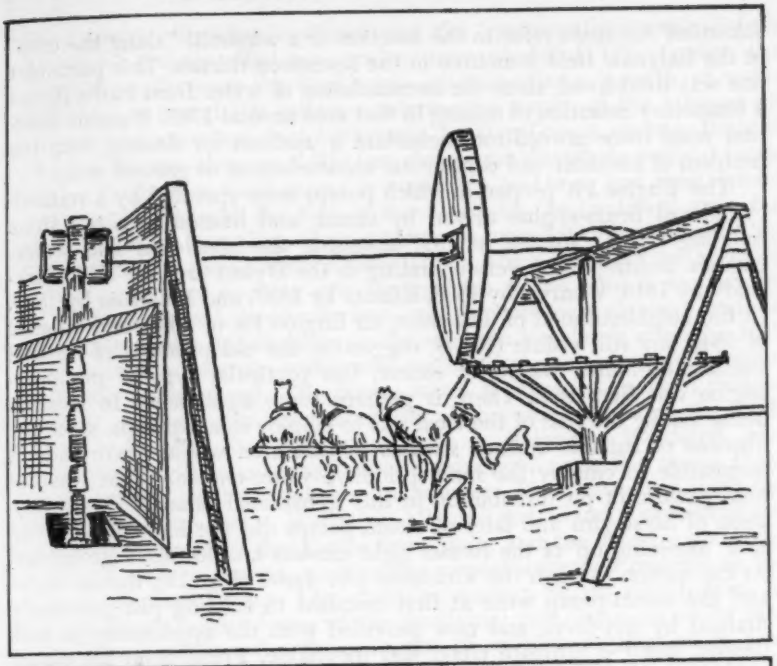
Given this social context then, if the individual mining enterprises were to break new ground, they had eventually to probe deeper, and in so doing, to overcome the main obstacle to deep mining – the problem of underground water.

THE TRANSITIONAL PHASE

This period, roughly from 1750 to 1850, saw the first attemps to deal with pit drainage by mechanical means. The day-level drained the upper levels of the coal measures by using a simple gravity flow. What was now required, if the vertical range of mining was to be extended, was some device to *lift* the water from the pit bottom.

Among the earliest was the 'water-engine', which utilised the flow of stream or lade to turn a huge wheel whose axle, fixed across the mouth of an adjacent shaft, carried an endless chain of buckets that raised the water from its gathering place in the pit-bottom sump. Balbirnie erected one on the South bank of the Leven in the seventeen-seventies, on a spot now occupied by the Rothes Paper Mill; it boasted a wheel of twenty-six feet in diameter. Further down the Leven, Balgonie had used a similar 'engine' since 1731, and replaced it with a larger model in 1785, which drained his seams to a depth of 180 feet; this was some eighty feet below sea-level – a significant advance on the range of the old day-level. On the Scoonie Burn, another water-engine drained the Durie coals [8].

More widely used, however, because not restricted to a riverbank location, was the Horse Gin, in which the flow of a stream was replaced by horses, and was therefore similar in principle to the oxen-operated 'sakhia' of Egypt (Fig. 13). Such Gin pits were fairly widely scattered over the region in the late eighteenth century, and seem to have been employed for the raising of men and coals, as well as water (Fig. 14). There were also attempts to harness the power of the wind, since a 'Windmill Pit' is shown on an eighteenth-century Wemyss Plan and the



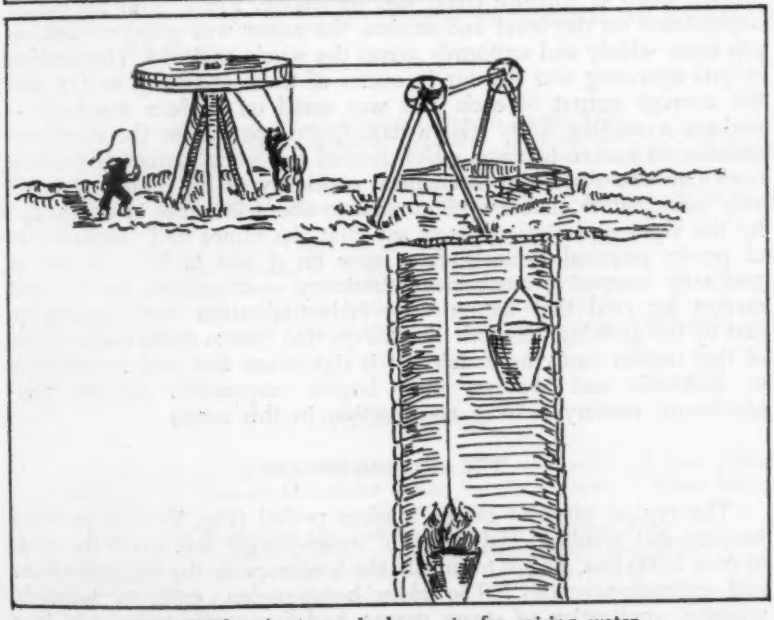


Fig. 13 (above) An early horse-gin for raising water.
Fig. 14 (below) Another form of horse-gin for raising men and coals.
After A. MacNeil Houston's *Auchterderran* [Fife] : a parish history.

Statistical Accounts refer to the erection of a windmill "along the crop" in the Balgonie field sometime in the seventeen-thirties. This particular one was short-lived, since the accumulation of water from faults forced a temporary cessation of mining in that area around 1743. It seems likely that wind force proved too inconstant a medium for dealing with the problem of constant and continuous accumulations of ground water [9].

The 'Engine Pit' proper, in which pumps were operated by a vertical-cylindered beam-engine driven by steam, and housed in a tall stone building (Pl. 4), existed at first alongside the horse-gins and water-engines. Steam-pumps were operating in the Dysart area by 1791, Kirkcaldy by 1818, Wemyss by 1838, Kilmux by 1837, and Balbirnie by 1840. In the neighbourhood of Thornton, an Engine Pit of 1830, and another of 1846, are still visible (Pl. 4), suggesting the old pitheads of disused Cornish tin-mines, where, of course, this particular type of pumping-engine was first used. There is perhaps some significance in Dysart's being among the first of the local pits to employ steam-pumps, since the absence of suitable surface streams in that area would have made it impossible to employ the more primitive water-engine. What was the total pattern of pit distribution in this transitional phase? The application of horse-gins and later of steam-pumps did not immediately lead to a 'loosening up' of the former tight clusters and localised groupings. As the section through the Kirkcaldy pits shows (Fig. 12), the horse-gin and the steam-pump were at first installed in existing pits previously drained by day-level, and now provided with the opportunity to sink deeper. But the ultimate trend was inevitable. Freed from his earlier dependence on day-level and stream, the miner was going to sink his pits more widely and uniformly across the whole coalfield. The number of pits operating was still far in excess of those operating to-day, and the average output of each unit was small on modern standards – perhaps averaging thirty tons a day. Quite apart from the continued reliance on human haulage, which limited the lateral extent of working from any one shaft, the mechanical efficiency of his pumps was still only sufficient to enable a pit to sink to about 300 feet in depth. But by the eighteen-forties we may say that the miner had broken free of purely physical controls; from now on it was to be a matter of gradually increasing mechanical efficiency – stimulated by the vast market for coal that nation wide Industrialisation was opening-up, and by the growing net-work of railways that was to make every corner of that market easily accessible. (It is significant that coal-owners such as Balbirnie and Wemyss were largely responsible for the mid-nineteenth century railway construction in this area.)

THE MODERN PERIOD

The typical pit-head of the modern period (Fig. 5) with powered haulage and winding, and powerful steam-pumps that drain the coals to over 3,000 feet, began to invade the landscape in the eighteen-sixties and eighteen-seventies. The older beam-engine, with its relatively wasteful application of steam power, had frequently to operate in a series of 'lifts', from the lowest pit-bottom sump, via several intermediate stations, to the surface. The newer pumps of the modern phase were

based on the horizontal-cylinder and the 'reciprocal' principle, which meant far greater efficiency, and a more powerful 'lift'. To-day, the Wellesley colliery on the Buckhaven coast handles a 'growth' of water estimated at over 1,100 gallons a minute; the pumps of the Michael pit on the Wemyss coast deal with some 1,200 gallons a minute. Both of these shafts are close on 2,000 feet deep, and the whole vertical range of the Productive Coal seams is accessible to them, and their lateral continuation beneath the bed of the Forth. In the landward area, the new Rothes sinking (Fig. 6) goes down to over 3,000 feet, opening up vast reserves in the Limestone Coal Group. These advances are revealed in the pattern of working pits to-day. The whole field is worked by ten, widely spaced, large pits from which every part of every seam is accessible; while the abolition of the separate leaseholds after the 1947 nationalisation permits systematic exploitation and planned development for years ahead. The future trend is towards an even smaller number of larger pits. By the middle of the nineteen-sixties, the landward pits near the outcrops, such as Balgonie, Randolph and Wellsgreen, will have gone out of production, since the seams there are relatively shallow and few in number. The future lies with the three big coastal pits – Wellesley, Michael and Francis, exploiting the undersea reserves in the Productive Coals; and the latest unit in the landward area – Rothes, working the almost untapped reserves in the Limestone Coal Group. The changing pattern of pit distribution, as well as the changing forms of the invididual pits, leave no doubt that the basic condition for the advance of mining in this small area of Fife, has been the successful struggle to overcome the problem of underground water.

[1] *New Statistical Account of Scotland.* Wemyss Parish, 1838.
[2] *Report of the Scottish Coalfields Committee.* Cmd. 6575. H.M.S.O. 1944.
[3] Plans of Balbirnie Estate 1823, and Ordnance Survey Six-Inch Sheets, 1856, with Balbirnie mining-data inserted. Balbirnie Estate Office, Markinch, Fife.
[4] Fraser, Sir William. *Memorials of the Family of Wemyss of Wemyss,* Edinburgh, 1888.
[5] *Old Statistical Account of Scotland.* Markinch Parish, 1792.
[6] *New Statistical Account of Scotland.* Kennoway Parish, 1838.
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THE ECONOMIC CONQUEST OF THE HILLS

A COMMENTARY

LESLIE SYMONS

THE stimulation of production from relatively poor land has been examined at length by agriculturalists, foresters and others in many recent studies [1]. In geographical literature, there has been little attention to the matter, although geographers, as specialists in the weighing of economic and social as well as physical factors, should be able to make a contribution to this practical problem. This commentary aims at indicating an assessment of some common issues that have seemed of major importance in the course of personal investigation into the position in Scotland and Ulster. A more detailed discussion of some of the factors hindering fuller utilisation of the Ulster hills has appeared elsewhere [2] and this article will adopt a general, rather than a regional or specialised approach.

The first question that arises is whether or not the hill lands merit investment and, since space restrictions preclude a detailed review of the case, the writer can say merely that it seems to him beyond dispute that, in a world of scarce resources, returns from all classes of land should be maximised. Maximising returns implies adjusting input to the level at which profit will be greatest without running down capital assets, which include land fertility. By definition it excludes wasteful application of resources that could be more effectively used elsewhere, as in improving more fertile lowland country. In the past, exploitation, with a few notable exceptions, has aimed at maximising revenue with little input to maintain the capital value of the land, and investment has long been needed.

The dimensions of the problem are evident from the extent of the hill lands. About two-thirds of Scotland can be classed as hill land, twice the proportion for the United Kingdom as a whole. The need for effective use of the hills is correspondingly greater in the Northern Kingdom and is greatest in the Highlands, where, underlying the whole social and economic problem of development of the ten million acres of Argyll, Perthshire, Inverness, Ross and Cromarty, Sutherland and Caithness, is the fact that only 803,000 acres or eight per cent is cultivated.

A comparison of fertility with earlier days can only be gained through farm records of livestock numbers and weights and an accurate picture is impossible. But crops of lambs and wool inevitably deplete accrued fertility in nitrogen, phosphorus and calcium, and there has been little manuring of the hills to replace these substances. In the Southern Uplands, grazing has been continuous, at least from medieval times when the monastic houses maintained large flocks of sheep for their wool [3], but in the Highlands, the hill grazings have been extensively used for only a comparatively short period. The coincidence of this period with that of commercial grazing illustrates that, although grazing depletes fertility, other uses are practicable only to a limited extent.

Two hundred years ago, the hills were simply 'waste' to most farmers and writers. Although the term did not imply that hill land was completely unused, it correctly indicated the low value placed upon moor and mountain. Sheep farming in the Southern Uplands had reached an advanced stage of organisation [4], but in the Highlands the emphasis in agriculture was on crops and cattle. Under the pressure of population in the eighteenth and nineteenth centuries, the limit of cultivation was pressed upwards to over 1,000 feet even in some parts of the wet Western Highlands and Irish hills. With the decrease in the population of the glens and the import of cheap grain, the margin fell again in the latter half of the nineteenth century. The folk who toiled at the fields on the hillsides had learnt that the combination of rain, mist and wind minimised their returns.

In the early attention to sheep farming in the Pennines and Southern Uplands, there was implicit recognition that basically the husbandry of the mountain districts must be directed at getting the maximum production in the long term from the great expanses of rough grazings, and by the eighteenth century the fundamental practices of modern sheep farming had been systematised. It was in their comparative inability to make full use of the hills that the tacksmen and sub-tenants of the Highlands revealed at this time that they had insufficient knowledge to come to terms with their environment. The farming system was based too rigidly on crops and cattle, further hampered by run-rig and all its endemic faults. Oats, bere and potatoes, mainly for human consumption, occupied the continuously-cropped infield and the irregularly-laboured parts of the outfield. Highland black cattle formed the principal exportable product and they were being driven south to English pastures as early as the fourteenth century [5]. The hindrances to the trade were removed after the Union of the Parliaments and it continued to grow throughout the eighteenth century, but the beasts were light and thin. The care bestowed on their cattle by some of the farmers of Galloway was rarely to be seen in the Highlands, and contemporary writers almost everywhere found the numbers of cattle too high in relation to the available food supplies, with little attention given to improvement of husbandry. The harmful effects of overstocking, poor feeding and squalid housing were accentuated by bleeding and other primitive concepts of veterinary medicine [6].

Idealistic pictures of summer days at the shielings cannot obscure the reality that the traditional cattle-tillage economy was unsuited to the nature of the Highlands and incapable of maintaining the growing population. It was unfortunate and ironic that the introduction from the southern districts of a hill farming system based on hardy creatures that could utilise the hill grazings sent the pendulum to the other extreme. Sheep farming was only one cause of depopulation (the 'tacksman emigration' of the seventeen-seventies preceded the introduction of the system) and high rents, crop failures, religious friction and optimistic propaganda for the New World were others. But the coming of sheep farming undoubtedly did result in population being decreased where, more wisely applied, it could have lessened the numbers that had to go.

Hardy sheep which could exist throughout the year on the hill grazings, finding their own food and receiving supplementary fodder only in severe snow conditions were the pre-requisite of commercial hill sheep farming and it was the absence of such stock, as well as of an understanding of the potential of the hill grazings, that inhibited its earlier development in the Highlands. Sheep had shared the lower grazings – the only ones that were used – with cattle throughout the centuries, but in small numbers only. The native Highland breed was white-faced, small, ill-shaped and not particularly hardy. The fleece was extolled by those who like the breed as "a fine pile of wool" [7] and of "soft down" [8] but it seems to have contained a high proportion of hair. The sheep were folded in winter and spring and housed at night, and were rarely far from the farmstead. In contrast, the Blackface and Cheviot breeds, though their qualities had not been stabilised at the end of the eighteenth century, had already been developed in the Southern Uplands as true mountain sheep. Criticisms of the Blackface were based on the coarseness of the wool and its susceptibility to braxy but in a few years it had proved its hardiness on West Highland hills. The Cheviot was also introduced into the Highlands before the end of the eighteenth century, and with the emergence of the North Country type, this became the dominant sheep in Sutherland and Caithness. The Cheviot received the encouragement of the British Wool Society whose representative toured the Highlands in 1792, though contemporary English buyers advised some farmers not to change from the Blackface [9] and in most parts of the Highlands, the Blackface has never been displaced.

With the introduction of the improved sheep, often accompanied by shepherds skilled in their rearing, the higher and more remote parts of the hills were brought into economic use for the first time. Contemporary writers on the whole welcomed the new development. A contributor to the *Old Statistical Account* [10] regretted that "in all the peninsula of Kintyre there is but one considerable sheep flock" and expressed the view that there should be many more and that they could be introduced without the necessity for evictions. "That our mountains are better adapted for sheep than for black cattle, cannot admit of a doubt" wrote another observer [11], "under the sheep system, they make a much better return both to the farmer and to the landlord; and furnish, in the wool of the sheep, a large fund for manufacture and for commerce".

In the ensuing one hundred and fifty years the rise of the sheep industry was followed by its decline in the face of overseas competition in wool, and later in meat, and by the phase of grouse and deer. In 1939, when maximum home production of food was a cornerstone of official policy, Fraser demonstrated the value of sheep, stressing the fact that the hill lamb was completely the product of its grazings, not converting imported feeding stuffs, as pigs or poultry might be [12]. Yet at that time, hill sheep rearing did not pay, and many flocks were saved from dispersal only by the prospect of loss of acclimatisation value. On many West Highland farms, there was a record of declining fertility and increasing mortality, and experiments suggested a cause in the poverty of pasture in late winter and early spring. The need for

good wintering was apparent, but hill farmers were in no position to pay for it.

Twenty years later, the economic situation is otherwise. Hill farming has enjoyed a period of prosperity and is attracting capital which not only encourages more attention to good husbandry, but makes it financially possible.

Since the Second World War, however, forestry has also become a major user of hill land in mountain districts. Re-afforestation of suitable land is rarely challenged in principle, but the clash between farming and forestry in practice has developed to major proportions. There is strong logic behind the idealist viewpoint, supported by the agents of state re-afforestation and state aid to agriculture, that the two can exist for mutual benefit, but few hill farmers can see the matter in this light. Unfortunately the best land for planting is also generally the best for grazing. The agriculturalists' view that forestry should be restricted to the poorest areas is naturally not in favour with the forester who has to justify expenditure by results. There are, however, some commendable examples in Scotland of planning for the orderly development of forestry and farming, both by public and private enterprise, Figure 1 illustrates an example of such development in Kintyre. The planting of the Carradale estate, begun in the thirties when hill farming was in an exceedingly depressed state is now virtually completed. The farms selected for preservation have been modernised and let to tenants of the Forestry Commission and some members of the farming families find employment with the Commission. The forest blocks provide protection for the grazings and access from low to high levels has been preserved except in the case of area 'X' which was planted before the need to preserve the downfall was appreciated. Since, in British forests, planting is generally carried out only to about 1,000 feet, and very rarely to more than 2,000 feet, there is usually an area regarded at present as unplantable above the forest line, and this should always be preserved for grazing.

It is unnecessary to discuss here the progress of forestry in Scotland or the possible limits to afforestation, as these have been widely discussed in recent years in many journals including the *Scottish Geographical Magazine* [13]. The present hindrance to the Forestry Commission's progress in the difficulty of acquiring land, must, however, receive comment. It illustrates the stage of competition reached in the use of the hill land and, simply because there is competition for land, rebuts the arguments of those who see no economic future for the hills. It is true that the competition is between a body wholly financed by the state and an industry subsidised by the state, and may thus appear to be unreal. In fact, however, the subsidisation of hill farming is now comparatively small. Payments under the hill sheep subsidy scheme have not been made since 1952, except for a special payment after the bad winter of 1955, owing to the comparatively healthy state of the industry, and this is due to favourable marketing conditions throughout all branches of agriculture. Most of the current expenditure is in capital improvements in farmhouses, buildings, fencing, drainage and reclamation by ploughing and reseeding, which are only making up for the lack of investment in previous decades. The subsidy for hill cows kept

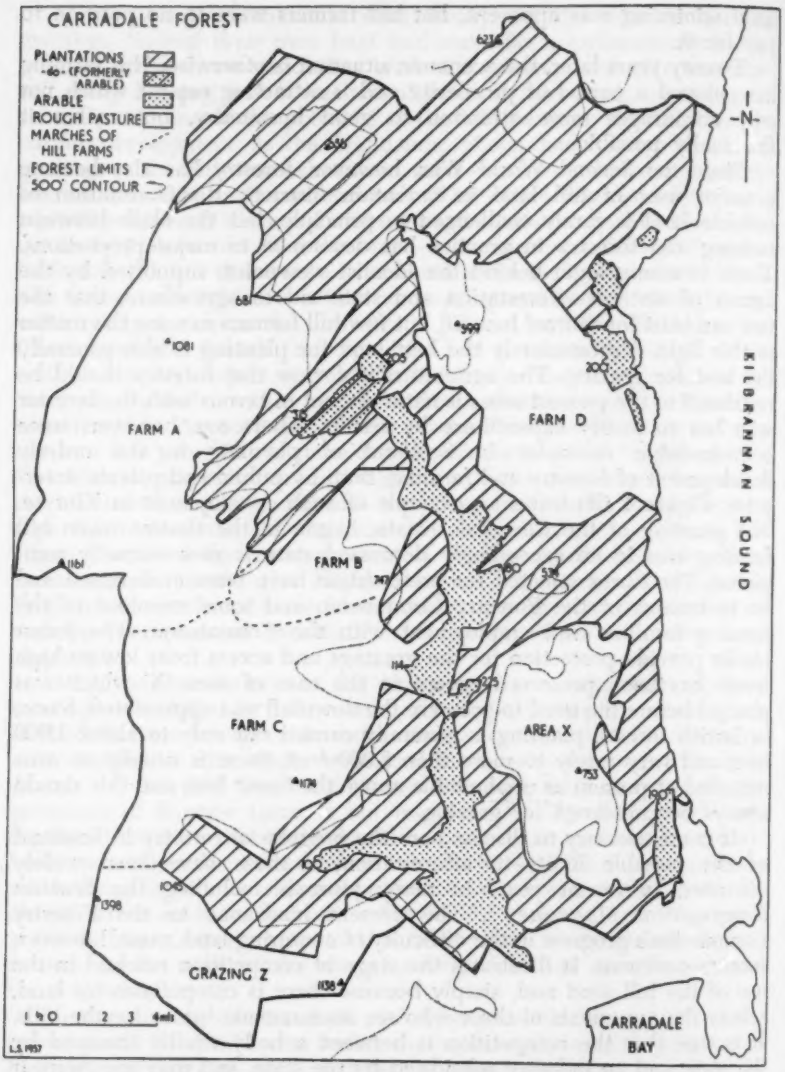

Fig. 1 Carradale Forest, Kintyre: an example of an estate administered by the Forestry Commission and the Department of Agriculture for Scotland. Unplanted areas are to be permanently reserved for farming. Access to hill grazings is preserved except for "Area X" which was surrounded by planting before this policy was adopted. "Grazing Z" is let to a neighbouring farm, the lower land having been planted.

in breeding herds on hill land is now the only regular subsidy available exclusively to hill farmers. Other subsidies, such as for calf-rearing, and purchase of lime and fertilisers, are equally available to the lowland

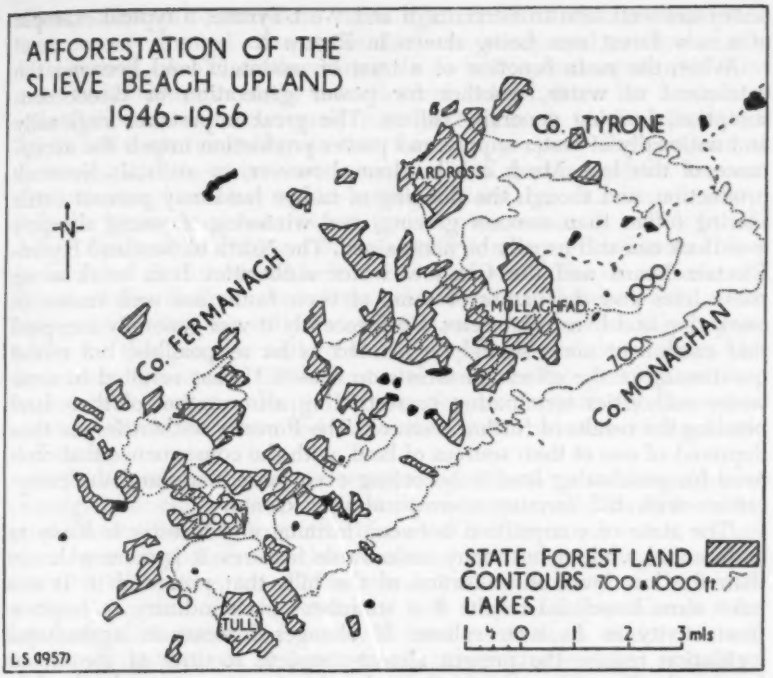

Fig. 2 An example of afforestation in Northern Ireland made possible by the purchase of small units of marginal land. Most of the land above 700 feet and much of the lower ground was uncultivated and indifferently grazed. Holdings of as little as seven acres were purchased, the average being about 80 acres.

farmers who collect most of the other subsidies and benefits of guaranteed prices. It is probable that hill farming is no longer receiving treatment more favourable than other branches of farming [14]. As long as the present national policy of protecting agriculture is maintained, hill farming is likely to remain prosperous without special measures. Meanwhile, the social and strategic benefits of afforestation should ensure the continued prosecution of the Commission's programme, and hence a state of competition is likely to continue. The experience of the Forestry Division of the Ministry of Agriculture for Northern Ireland suggests that the tendency in Scotland to accept smaller areas for planting should facilitate acquisition. The Northern Ireland authority is finding no difficulty in acquiring land for planting and is building up a large reserve of plantable land, amounting already to over half of its total requirements under its fifty-year programme. This is mainly because the Ministry is prepared to accept small patches of fifty or a hundred acres in districts where many farms are economically marginal, relying on later offers of neighbouring land to build up an economic unit for planting. In the meantime, farming can continue under tenancies from the Ministry. The results of a decade's operation of this

policy are well seen in Fermanagh and West-Tyrone, a typical example of a new forest area being shown in Figure 2.

When the main function of a tract of mountain land becomes the catchment of water, whether for power generation or direct consumption, farming generally suffers. The great importance regionally and nationally of water supply and power production impels the acceptance of this loss. Much can be done, however, to maintain livestock production, and though the flooding of in-bye land may prevent cattle rearing (other than summer grazing) and wintering of young sheep, a ewe flock can still usually be maintained. The North of Scotland Hydro-Electric Board and the Glasgow water authorities both work along these lines and the names of some of their farms are well known in marketing and livestock circles. Until recently it was generally accepted that catchment areas should be planted as far as possible, but recent questioning of the effects of forests on run-off [15], has resulted in some water authorities terminating or restricting afforestation of their land pending the results of further research. The Forestry authorities are thus deprived of one of their sources of land, with the consequence that their need for purchasing land is becoming even more acute and the competition with hill farming correspondingly keener.

The state of competition between farming and forestry is likely to endure and while it has many undesirable features, it is more welcome than the low level of utilisation of the hills that preceded it. It can have some beneficial results if it stimulates each industry to improve productivity in its own sphere. If changes forecast in agricultural legislation reduce the present almost-complete security of the tenant farmer, the Forestry authorities may be able to secure more land, while hill farmers, in competition with them and with one another, may find that higher rents stimulate a search for higher returns. Higher returns undoubtedly are possible, for although the physical environment will prevent subjugation of the hills to economic objectives comparable with those of the plains, the limits are far from being reached, the economic conquest of the hills remaining partial and unsatisfactory. In seeking fuller utilisation, forestry benefits from a co-ordination of effort and direction of capital impossible in an industry composed of many independent units and the work of the government advisory services and independent research bodies is accordingly all the more necessary for the improvement of productivity in hill farming.

An increase in productivity on hill farms may be secured through: (a) heavier stocking; (b) lower mortality; (c) higher quality; (d) more twinning in hill flocks; and (e) by more cattle. Cattle may not make much direct contribution to the profitability of the farm, but they do pay their way and keep roughage under control. Twenty-five acres or so of arable land is sufficient to provide supplementary feed for a small herd of hardy cattle, so that few farms even in the upper glens are debarred from this kind of enterprise. Selective breeding has provided, in the Galloway and the West Highland cattle, hardy beasts far superior to those associated with the traditional cattle husbandry of the Highlands, and there are excellent markets both for pure-bred stock and for cross-bred stores such as the famous Galloway x Shorthorn blue-greys. An increasing number of farmers have been encouraged by

subsidy schemes to introduce cattle to their hills and have found that there is only limited competition between sheep and cattle, but the development of hill cattle rearing faces widespread apathy [16]. Also it can only make use of the more accessible land. Even the hardy and agile Galloways are only rarely seen grazing parts of the hills above 700 to 800 feet, reminding us that these are properly the province of the sheep, and there are vast acreages of hill grazings which, because they lack complementary fodder-raising lowland, can only sustain sheep. Only the highest and most remote grazings are not easily usable by hill sheep. The summit ridges well over 3,000 feet are grazed where they are included in the normal heft or hirsel grounds. The decrease in the size of wether flocks is commonly held to reduce the use made of the high grazings, but most flocks retain a proportion of 'wedders' specifically for this purpose and to lead the ewes out of deep snow. The alternative of keeping the highest and most remote grazings as deer forests, with sheep to occupy the more favourable parts, is reasonable, but deer should be controlled in number in the interests of the cattle and sheep.

With regard to the improvement of productivity in sheep, recent investigations suggest that on most farms there would be little to be gained from changing from Blackface to Cheviot or vice-versa, as has often been suggested, no clear financial advantage being found in either [17]. With either breed it is necessary to concentrate on the health of the flock, not only by breeding and veterinary practices but by improving the amount and quality of food available in winter. A small increase in arable land or meadow will help with the sheep as well as cattle and current reclamation of rough land for arable purposes is one of the most important forms of improvement. The possibilities are severely limited by relief in most highland glens, but a few acres makes a great deal of difference to a farm with only twenty or thirty acres of improved land. An appreciation of this point has led in Northern Ireland to a special government scheme for reclamation of difficult ground in Tyrone and Londonderry and over 4,000 acres have been added to arable land on hill farms [18].

The use of improved land for grazing hoggs at home in the winter reduces costs by from about twenty-three to over thirty shillings per head at the present time — one quarter of away-wintered hoggs were found by the West of Scotland Agricultural College's study of Cowal hill farming to be sent as far as the north-eastern counties [19]. Good winter grazing is also invaluable for the ewes, especially for those bearing twins. The alternative or supplementary practice of giving hay to ewes is more controversial. The majority of hill farmers resist so doing because they fear it will reduce the hardiness and foraging capacity of the sheep. The significance of this hardiness for the development of utilisation of the hills has already been stressed, but it is permissible to question the necessity for too strict an adherence to the beliefs of a century ago, if modern methods make practicable the production of the necessary fodder. It is at least possible that by training hill sheep to take small but regular portions of hay in winter there would be marked increases in production without loss of hardiness, and it is noteworthy that there is widespread agreement that no deterioration in

hardiness of rams can be attributed to specialised breeding methods with hand feeding [20]. Inaccessibility, or the high cost of purchase and transport, however, preclude the use of hay on some grazings where its desirability for ewes is accepted. Some farmers think that their hill land is being so depleted of minerals that hand-feeding will be essential unless stocks are reduced, and with three to five acres per ewe common at present, this would seem to be a retrograde step. Rather should the aim be improvement of output by increasing input. If this be accepted, the aim must be to improve vegetation on the hill in summer, to put stock into the best possible condition, to increase the yield of hay and/or silage from land accessible for the purprose and to improve vegetation in autumn and spring to minimise dependence on hay. The success or failure of these efforts would have to be judged from the quantity and quality of stock. It would be expected that there would be a considerable improvement in the percentage of lambs to ewes (commonly only sixty or seventy in pure hill flocks), an improvement in the number of twins, not at present sought because of lack of food for the ewes carrying and bearing them, and improvements in weights of carcasses and fleeces.

Ways of increasing productivity which have received much attention in recent years include hill drainage, fencing, provision of shelter belts, bracken eradication, care of heather in burning and measures to overcome the depredations of the heather beetle, and liming and reseeding of pastures. Striking improvements can be effected by one of these measures alone. Drainage is perhaps the work which has most benefited by recent technical developments, especially the introduction of the Cuthbertson drainer. In Argyll, it is said that it used to be reckoned that the costs of drainage would eventually be recovered from an increase in the weight of wool [21] and one hopes that gains in output may still offset expenditure. On many farms, significant increases in production are being experienced following improvement schemes.

So far, however, there has been no evidence of increases in productivity comparable with some reported from New Zealand. An example of a striking increase resulting largely from top-dressing is given in Table I. The whole of the increases since 1951 are ascribed to aerial top-dressing and reseeding [22]. The experiences of one farmer could be misleading, but application of fertiliser from the air in New Zealand increased from 5,000 tons on 48,740 acres in 1950 to, in 1953, 144,800 tons on 1,376,000 acres [23]. The normal practice in New Zealand is to apply superphosphate at the rate of 2 cwt per acre, and this may be accompanied or followed by sowing of clovers and grasses. The cost of spreading superphosphate by air varies from about five to about nine shillings per acre, or from 15 to 25 per cent of the total cost per acre (Table 2). A six-year programme of oversowing and top-dressing with redressing every three to four years is recommended. These costs are borne readily in New Zealand and might be economically acceptable in the British Isles. This method of raising productivity is particularly attractive in not initially requiring additional regular labour – a point of no small importance in the Highlands today. Unfortunately, whereas it has been found that the yield from New Zealand hills can be improved substantially by application of phosphates alone (though not by

SEASONS	AVERAGE TOTAL WEIGHT OF WOOL (lbs.)	AVERAGE NO. OF SHEEP SHORN	AVERAGE FLEECE WEIGHT (lbs.)
1942-43 to 1944-45	9,630	1,222	7.9
1945-46 to 1949-50	13,410	1,445	9.3
* 1950-51 to 1954-55	18,250	1,772	10.3

* Aerial topdressing and oversowing began in this period.

TOTAL AREA OF FARM : 1,740 acres; 600 feet to 3,400 feet;
LOWLAND PASTURE AND ARABLE : 180 acres;
AERIAL TREATMENT FROM 1951 : annually at 80-130 tons superphosphate with oversowing of clover, cocksfoot and cowgrass.

Source : Crawford [22]

Table I. PRODUCTION INCREASES ON A FARM ON THE SOUTH SIDE OF THE WAIRAU RIVER IN MARLBOROUGH, NEW ZEALAND.

COST COMPONENTS	GISBORNE-WAIROA	TARANAKI
	£ s. d.	£ s. d.
Cost of fertiliser ex works	- 18. 11.	- 18. 11.
Railage on fertiliser	- 7. 8.	- - 6.
Cartage cost from rail to airstrip	- 3. 7.	- 2. 6.
Labour provided by farmer at airstrip	- - 3.	- - 3.
Aerial spreading cost by aircraft	- 4. 9.	- 8. 0.
Annual interest on capital invested in airstrip	- - 6.	- 1. 2.
* Other	- - 1.	- - 3.
Cost per acre to spread 2 cwt. superphosphate etc.	1. 15. 9.	1. 11. 7.

* Includes such costs as annual maintenance of airstrip and value of accommodation for aircrew provided by farmer.

Source : Scott and Mason [23].

Table 2. COST OF SPREADING SUPERPHOSPHATE BY AIRCRAFT AT 2 CWT. PER ACRE IN TWO DISTRICTS OF NEW ZEALAND

spreading seed alone) [24], it is thought that with the high acidity prevailing on British hills, it would be essential first to apply lime at a minimum rate of 15 cwts per acre and, desirably, 2 tons per acre [25]. Owing to the high operating costs of the larger aircraft required for dropping such heavy loads, it is unlikely that the cost of the air operations alone would be under £2 per acre for the lighter dressing of lime. Spreading lime and fertilisers by tractor and hand labour on accessible, though remote, land costs appreciably less, especially if extra

labour is not employed, so that aerial top-dressing does not appear an economic proposition in the British Isles at the present time.

On the other hand, experiments in Britain have not been wholly discouraging and if proposed research programmes are pursued and more knowledge is gained of the effects of applying lime and fertilisers on different types of land, and new and more suitable types of aircraft are evolved, the position may change. Even if heavy dressings cannot be made economically, trace elements especially cobalt, which are applied in New Zealand at a cost of sixpence to one shilling per acre, may feasibly be applied from the air with advantage in the British Isles. Recently an agriculturalist closely connected with hill farming has expressed the opinion that aerial top-dressing has been tried only partially in Britain and then been condemned [26]. It is to be hoped that it has not, in fact, been condemned and recent interest shown in the questions surrounding the use of aircraft suggest that it has not. The geographical differences between the districts in New Zealand, where these methods have been succesful, and the northern and western hills of Britain cannot be overlooked, but we still have not sufficient data to judge the significance of the broad similarities and detailed differences.

In Scotland, the larger estates and farms are big enough to allow of some economies of scale in experiments. It is from them, as well as from the experimental farms of the colleges and the Hill Farm Research Organisation, that one looks for an effort to get away fom some of the traditional methods employed centuries ago. To the present writer, it seems axiomatic that sheep must be the main medium for increasing productivity in hill farms, with cattle an important secondary line, and that flocks should therefore be increased rather than decreased. But this presupposes great increases of input, with improvement both to improved land and rough pastures. The geographical world, in collaboration with other specialists, can make a modest contribution through the provision of more thorough data relating to climate, soil, vegetation, land ownership and occupation, and the variation of economies with these, and all other factors. Progress, however, is slow. Fourteen years have elapsed since the Balfour Committee [27] followed up earlier calls for an extended ecological survey of hill pastures; four years have passed since Dr Tivy echoed these proposals and suggested "some type of land utilisation survey of the hill grazings of Scotland.... complementary to the existing Land Utilisation Survey of Great Britain, in which every aspect of the environment of hill land might be treated" [28].

There has been no reduction in the need for such a survey; rather has the intensification of use stressed the ever-increasing desirability of co-operative research, in this and other aspects of the hill lands, to provide a sound basis for co-ordinated planning.

The co-operation of the Forestry Commission, the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland is gratefully acknowlegde. The responsibility for the interpretation of the facts supplied rests solely with the author.

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SIR JOHN FRANKLIN

A NOTE ON THE ABSENCE OF RECORDS ON THE SHORES PAST WHICH HE SAILED DURING HIS LAST VOYAGE.

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Captain Sir John Franklin, commanding H.M. Ships *Erebus* and *Terror* sailed from the Thames in May 1845 to complete the discovery of a North-West Passage. Only two records, deposited on land by his officers, have hitherto been recovered. Both were found on King William Island in 1859 by Lieutenant William R. Hobson, second in command of the private search expedition led by Sir Leopold M'Clintock. [1]

Franklin may have left records in cairns which had disappeared before the search began, or were overlooked by the relief expeditions [2], or were built in one or other of the few places that he may have visited but the relief expeditions did not reach. [3] But these records, if any, are very unlikely to have been numerous, and that he apparently left none on the shores past which he must have sailed before he reached the vicinity of King William Island was most unfortunate. The relief expeditions ascertained from the dates on the monuments erected over the graves of three of his men who had died at Beechey Island that he had spent the first winter (1845-6) there, but they found no record and hence had no guidance, other than his orders, to the direction in which he had sailed afterwards. Even if they had known the right direction they could not in all probability have reached King William Island in time to rescue any survivors, but they carried out during the next few years extensive searches in parts of the Arctic which in fact offered no prospects of success.

Franklin's omission to mark his route by means of records left on land was quite contrary to what was expected by the Arctic authorities. Sir Edward Parry remarked in 1847 that whaling ships might obtain information about the absent expedition by "looking out, in prominent positions, for the piles of stones and flag-staves under which in former expeditions it has been customary to bury bottles or copper cylinders containing some account of their proceedings." [4] Colonel Sabine stated that Franklin would "doubtless have left memorials in the usual manner at places where he may have landed," [5] and Sir John Richardson declared that "it was understood" that Franklin would "cause piles of stones or signal posts to be erected on conspicuous headlands at convenient times." [6] Again, the Admiralty in 1850 directed the commander of one of the relief expeditions to take the utmost care in leaving memorials of his track "in the usual manner and in every prominent place...." [7] In short, it was taken for granted that the relief expeditions would find that Franklin had left records on land under conditions similar to those under which his predecessors had left their records, and this presupposition was fully justified. What seems to have been completely overlooked was that even if Franklin had done so he would not necessarily have marked his route in the systematic way that appears at first to have been expected.

When the relief expeditions in 1850-51 had found Franklin's first winter quarters at Beechey Island but no definite traces elsewhere in and around Barrow Strait, some authorities concluded that he had probably found the channels clear of ice and had consequently not delayed his progress merely to leave records on land. [8] Sir Albert H. Markham, as he stated in his biography of Franklin, came to the same conclusion. [9] This explanation is certainly the best that can be offered, and the purpose of the present article is to consider in detail the available evidence. Franklin was not ordered to leave records anywhere on land, but this omission did not absolve him from complying with the precedents which had been established by the commanders of the maritime Arctic expeditions that had sailed from Britain during the three decades before he sailed on his last voyage. It is, therefore, necessary to consider in the first place the circumstances under which these commanders had left records on land.

In 1818 the Admiralty sent Sir (then Commander) John Ross with two ships to seek a North-West Passage through Davis Strait and Baffin Bay. Ross sailed in H.M.S. *Isabella*, his second in command, Sir (then Lieutenant) William Edward Parry, in H.M.S. *Alexander*. For the purpose of ascertaining the set of currents

and also of affording the Admiralty chances of hearing of Ross's progress, he was ordered to throw overboard records in bottles frequently after he had passed northwards beyond the 65th parallel of north latitude. He was not told to leave records on land. [10]

During his voyage up the east side of Baffin Bay, a flagstaff was erected on one of the so-called Baffin Islands, [11] but no record is said to have been left. Parties went ashore at several other places on or near the west coast of Greenland, but apparently deposited no records, and on every occasion on which landings took place the ships were detained by ice or other adverse conditions. Parties landed on the west side of Baffin Bay at Possession Bay and Agnes Monument and took formal possession. This ceremony in the Arctic comprised unfurling the flag, planting the flagstaff in the soil, and, usually, leaving a notice stating that possession had been taken in the name of the Sovereign. [12] A flagstaff bearing an inscription was erected and a record was left at Possession Bay, and the same procedure was followed at Agnes Monument. [13] No more landings took place and Ross arrived home in November 1818. So far as can be gathered from the published narratives and the log books, [14] no records were left on land except at the two places which have been mentioned.

Captain David Buchan was sent by the Admiralty with H.M. Ships *Dorothea* and *Trent* in April 1818 to sail between Spitsbergen and Greenland towards Bering Strait, and to pass as close as possible to the North Pole. He was ordered to throw overboard records in bottles frequently after he had passed northwards beyond the latitude of 75° North, but was not told to leave records on land. [15] All his attempts to penetrate the Polar ice failed, and he was compelled to return home during the autumn. Many parties landed on Spitsbergen, and a flagstaff bearing a red flag was planted at the highest place reached by parties which tried to reach the summit of Rotge Hill, Magdalena Bay.No records appear to have been left either there or anywhere else on land. [16]

In 1819 the Admiralty despatched Sir Edward Parry with two ships, the *Hecla* and *Griper*, to seek a North-West Passage through Baffin Bay. He was ordered to throw overboard bottles containing records frequently after he had crossed the 65th parallel of north latitude, and, if he reached the north coast of America, to leave notices there for Franklin, who was to travel overland through Arctic America and to examine part of that coast. Parry was not told to leave records anywhere else on land. [17]

During the outward voyage through Baffin Bay and Barrow Strait to Melville Island, Parry and his officers left six records on land — one at Possession Bay; two on the east side of Prince Regent Inlet; one on Byam Martin Island; one on Melville Island between Point Griffiths and Point Ross; and another on that island at Fife Harbour. [18] The last record was deposited when possession was taken. [19] On five of the six occasions on which these records were left, the ships were either detained or progress was extremely slow, and on the sixth occasion it was considered of importance to make magnetic observations on shore. Parties landed at other places but apparently left no records. The winter was passed at Winter Harbour, Melville Island.

In June 1820 Parry travelled across that island and back, and deposited six records during the journey. Five were secured in metal cylinders; one was left in an empty meat tin. [20] Before he sailed from Winter Harbour, an inscription recording his visit was cut into a block of sandstone near the beach, and two cairns, each containing a record, were built within a few miles of the harbour. [21] After his departure from Winter Harbour, several parties landed on Melville Island but apparently left no records, and none are said to have been deposited on land during the return voyage [22] to England, where he arrived during the late autumn, 1820. He did not reach the north coast of America so left no records especially for Franklin. [23]

The Admiralty in 1821 sent Parry with two ships to seek a North-West Passage through Hudson Strait. He was directed, if he reached the north coast of the American continent, to leave notices there for Franklin to the east of the estuary of the Coppermine river, and to leave them occasionally also on the coast lying to the west of that estuary so as to increase the Admiralty's chance of hearing of his progress. He was not told either to leave records on land elsewhere [24] or to throw them overboard, and orders to do this were not issued again by the Admiralty to the commander of any Arctic expedition until Franklin sailed on his last voyage.

During Parry's outward passage through Hudson Strait and Frozen Strait, many parties went ashore on one of the Savage Islands and on Southampton Island. He and his officers then explored, principally in boats, the many bays and inlets on the east coast of Melville Peninsula between Repulse Bay and Winter Isle, where he passed the first winter (1821-22). No records, other than some which were intended only for members of the expedition, appear to have been left on land during any of these prolonged investigations. [25]

In May 1822 one of the officers travelled along part of the east coast of Melville Peninsula; he apparently left no records there. Before Parry left Winter Isle, the ships' names were painted on a rock, but the published narratives do not state that records were left. Parry then sailed northwards and tried, unsuccessfully, to pass through Fury and Hecla Strait. Many parties went ashore but are not said to have deposited records.

Parry spent the next winter (1822-23) at Igloolik, an island at the eastern end of Fury and Hecla Strait. Further extensive explorations were carried out by detached parties, but no records seem to have been left. [26] Parry had proved that Melville Peninsula was part of the American continent; and, therefore, before departing for home in 1823, he left, in accordance with his orders, a notice for Franklin on the mainland opposite Igloolik. This notice was buried under a cairn surmounted by a flagstaff which was fifty-six feet high, was secured by rigging, and had a ball at the top. [27] During the homeward voyage, parties landed on the Ooglit Islands and again on Winter Isle, [28] but apparently left no records. In short, the record for Franklin is the only one which seems to have been deposited on land, excepting notices left by detached parties for the information of other detached parties. [29]

In 1823 the Admiralty appointed Commander D. C. Clavering to take Colonel Sabine in H.M.S. *Griper* to Norway, Spitsbergen, and the east coast of Greenland for the purpose of enabling Sabine to continue in high northern latitudes his researches, by means of pendulum observations, into the configuration of the earth. The *Griper* sailed in May, took Sabine to Hammerfest, then to one of the Norway Islands (near Hakluyts Headland, Spitsbergen), then to the Pendulum Islands (east coast of Greenland), and lastly to Trondhjem. When Sabine had concluded his experiments the *Griper* returned home in December 1823. Only brief accounts of this voyage have been published. They contain no mention of Clavering's orders with respect to leaving records and do not state that any records were left. [30]

Captain G. F. Lyon was ordered in June 1824 to proceed in H.M.S. *Griper* to Wager River or Repulse Bay, and then to travel overland to the north coast of America and examine the eastern part of that coast. He was given orders by the Admiralty for his sea voyage, and by Earl Bathurst, Secretary of State for War and the Colonies, for his overland journey; and neither directed him to leave records anywhere. [31]

He was unable to enter either Wager River or Repulse Bay, and was compelled to return home in November 1824. During this voyage parties landed once on Southampton Island, twice on Coats Island, [32] and twice on the mainland between Cape Fullerton and Cape Dobbs. On one of these five occasions, the ship was detained by light winds; on each of the others, the purpose of landing was to obtain water or to make observations, or to do both these things. [33] No records are said to have been left at any of the places at which parties went ashore.

In 1824 the Admiralty sent Parry with two ships to seek a North-West Passage through Prince Regent Inlet. If he reached the north coast of America, he was directed to leave records there for Lyon (whose voyage has just been described) and also records and provisions for Franklin, who was to travel down the Mackenzie River to the sea and to explore the coast. Parry's orders stated also that a ship with stores for him would be sent to Bering Strait during the summers of 1826 and 1827 unless the Admiralty heard from him that these measures were unnecessary. Kotzebue Sound was named as the rendezvous; the ship was to leave a depot of provisions there before returning to the south, and records were to be deposited there by whichever party arrived first. Parry was not told to leave records on land except at the places which have been mentioned. [34]

During Parry's outward voyage, parties went ashore close to Cape Warrender in Lancaster Sound, and at another place near to the entrance of that sound. On both these occasions the ships were detained, and no records are said to have been left. [35] Parry then entered Prince Regent Inlet and wintered at Port Bowen.

In June 1825 one party, commanded by James Clark Ross, travelled northwards along the coast to beyond Cape York. He built a cairn at this cape but apparently did not leave a record there.[36] Another party examined part of the interior of the land; a third explored the coast to the southward as far as Fitzgerald Bay. No records are said to have been left. After leaving Port Bowen, Parry reached the east coast of North Somerset at Cape Seppings, and sailed southwards. Parties landed near Elwin Bay, between Batty Bay and Fury Point, and at Fury Point itself. On all these occasions no progress was possible in the ships and no records are stated to have been deposited. Shortly afterwards, one of the ships, H.M.S. *Fury* was so severely damaged that she had to be abandoned, and her stores were landed at Fury Beach. Before returning to England in the other ship, H.M.S. *Hecla*, Parry surveyed Neill Harbour, on the east side of Prince Regent Inlet. His narrative makes no mention of his having left records either at Fury Beach or at Neill Harbour,[37] and since he did not reach the north coast of America, he had no occasion to leave notices for Lyon and Franklin.[38]

The ship which was to convey stores to Bering Strait for Parry in 1826 and 1827 was intended also to assist Franklin who, it was hoped, would reach that strait from the Mackenzie. The ship selected was H.M.S. *Blossom*, Captain F. W. Beechey. His orders relating to his proceedings before he reached Bering Strait do not require mention; and since his duties with respect to Parry have been described, it suffices to state that he was instructed to erect signal posts and leave records for Franklin in 1826 on the Alaskan coast to the north of Kotzebue Sound. He was not to winter in the Arctic and if he received no news of either Parry or Franklin in 1826, he was to repeat in 1827 the measures which have been described. He sailed from England in May 1825. When he reached Petropavlovsk in July 1826, he received despatches stating that his orders regarding Parry were cancelled, for this explorer had returned home in 1825.[39]

Beechey then left records for Franklin at Chamisso Island, Cape Krusenstern, Cape Thomson, Cape Lisburn, near Icy Cape, and at Point Hope and Refuge Inlet. Signal posts were erected or directions for finding the records were painted on the rocks, and inscriptions were painted on a post near Point Belcher and on two posts at Cape Franklin.[40] Beechey then left the Arctic. He returned to Bering Strait during the summer of 1827, and left records or notices of some kind for Franklin at Cape Lisburn, Icy Cape, and Chamisso Island.[41] He then returned to England.

In 1827 Parry attempted to reach the North Pole by travelling from Spitsbergen across the ice in boats fitted for the purpose. His orders from the Admiralty did not require him to leave records.[42] Several parties landed on Spitsbergen and the adjacent islands during the outward voyage in H.M.S. *Hecla*, which was ultimately secured in Hecla Cove, Treurenburg Bay. The party which then tried to travel to the Pole, and, although it failed to reach it, did attain a higher northern latitude than any that was known on unquestionable evidence to have been attained before, landed several times on islands to the north of Spitsbergen. The officers who remained with the ship also landed on some of these islands and explored the surrounding country. Before Parry returned to England, a flagstaff bearing a copper plate with a description of the expedition was erected on the shore at Hecla Cove. No other records or memorials seem to have been left anywhere with the exception of notices intended for the guidance of members of the expedition.[43]

A private expedition in a paddle-steamer named the *Victory*, commanded by John Ross, sailed in 1829 in search of a North-West Passage. Ross entered Prince Regent Inlet, added to his stores from the depot made by Parry at Fury Beach in 1825, and left records there. During his voyage down the west side of the Gulf of Boothia, Ross took formal possession of Boothia Felix, which he discovered, at Brown Island, Port Logan, Cape Verner, and Andrew Ross Island. On Brown Island he left a record in a cairn. He took possession at Port Logan "according to the usual forms", so may have built a cairn and have left a record there. At Cape Verner he erected a beacon bearing a copper plate on which was inscribed the ship's name and the date, and he painted the same details on a rock. Whether he left records at Cape Verner, and in the cairn which he built on Andrew Ross Island, is not clear from his narrative.[44]

In addition to landing and taking formal possession at the four places which have been mentioned, Ross built cairns, but apparently left no records, at Elizabeth

Harbour, on an island near Cape Allington, and at Eclipse Harbour. On an island near this harbour he erected a beacon to which was fixed a copper plate similar to that left at Cape Verner.[45] He and his officers landed at several other places but apparently left no records. On every occasion on which they went ashore during the voyage southwards along the east coast of Boothia, the ship was for some reason detained. The actual voyage in the ship virtually ended when Ross reached his first winter quarters at Felix Harbour, for he was unable to sail more than three miles in the *Victory* in 1830, and more than four in 1831.

He and his second in command, his nephew James Clark Ross, made many sledge journeys, and during these James Ross took formal possession of his discoveries at Spence Bay, Matty Island, Victory Point, and the North Magnetic Pole. He built a cairn at Spence Bay, probably another on Matty Island, and may have left records at both these places, for he is said to have taken possession with the usual formalities. He left a record at Victory Point and another at the North Magnetic Pole, and built a cairn, but apparently did not leave a record, a few miles to the north of the Magnetic Pole.[46]

Ross spent a second winter in his ship at Sheriff Harbour and a third in Victoria Harbour, both on the east coast of Boothia. His narrative does not mention his having left records either at these places or at his first winter station in Felix Harbour. After abandoning the *Victory* in May 1832 he tried in vain to reach Baffin Bay and had to winter at Fury Beach. He left records there, and also at Cape Seppings in September 1832 and again in August 1833. After he had reached a whaling ship in Lancaster Sound in August 1833, he deposited a record at Possession Bay.[47] Several other records were left in various places but were intended only for members of the expedition.

In 1836 Captain (later Admiral Sir) George Back was directed by the Admiralty to proceed in H.M.S. *Terror* to Wager River or Repulse Bay, and then to examine by overland journeys part of the unexplored north coast of America. He was not told to leave records anywhere.[48] He could not reach either Wager River or Repulse Bay, for the *Terror* was beset in ice near the entrance to Frozen Strait in August 1836. She remained beset until the following July, and was slowly drifted towards the Atlantic. Back returned to England in 1837. He and his officers landed many times on Southampton Island while the ship was beset,[49] but neither his narrative nor the log book[50] state that records were left.

A question which now needs to be considered is whether many records are likely to have been left on land in addition to those which have been enumerated. Parry stated to an Admiralty Committee in 1851 that it appeared to have been the general practice to leave records at all places in which ships had wintered,[51] so he presumably left a record at Winter Isle in 1821 and one at Port Bowen in 1825, although his narratives do not state that he did so. Moreover, his first expedition was described by more than one eye-witness, and their published narratives do not invariably agree with respect to the number of records deposited. Parry during his journey across Melville Island in 1820 left at Bushnan Cove a record which he did not mention in his published narrative[52] but was mentioned in that of Dr Fisher, who accompanied him, and was found in 1851 by M'Clintock.[53] Again, Fisher stated that during that journey Parry left six records — one of which, however, was a piece of parchment left in an empty meat tin — whereas Parry himself in his narrative mentioned only three.[54]

Moreover, several records known to have been deposited in parts of the Arctic in which they were immune from interference by Eskimos, could not be found by later explorers. In 1851 M'Clintock searched in vain, between Point Griffiths and Point Ross, Melville Island, for the cairn in which Parry in 1819 had left a record.[55] Again, although Parry presumably deposited a record in 1825 before he left his winter station at Port Bowen, Captain Kennedy in 1851 could find no record there other than a sheet of copper marked *Hecla* and *Fury*, which he found in a cylinder lying on the ground near the site of Parry's observatory.[56] Records which were not mentioned in any of the available sources of information may therefore have been deposited in places in which they were not found. Nevertheless, the number of such records is unlikely to have been large, for the following reasons.

Firstly, although Parry did not mention in his printed narrative of his first expedition all the records described by Dr Fisher, he did mention eleven out of a total that seems to have been fourteen (including six deposited during his

journey across Melville Island), and if he had left as many records on land during his later expeditions, he would presumably have referred to most of these documents. Similarly, if Buchan in 1818, Lyon in 1824, and Back in 1836-7 had left records at the places at which they went ashore, at least brief mention would probably have been made in the published narratives.

Secondly, on many long stretches of coast no parties went ashore. For this reason, during Parry's outward voyage to Melville Island in 1819, records cannot have been left on North Somerset, Cornwallis Island and Bathurst Island; and one is very unlikely to have been deposited on North Devon, for the only parties that landed there were quickly recalled. [57] Similarly, Parry during his homeward voyage in 1820 cannot have left records anywhere on land between Cape Providence (Melville Island) and near Scott Inlet (on the west side of Baffin Bay); [58] and Back, during his outward voyage in 1836 in the *Terror* through Hudson Strait and part of Foxe Channel to the entrance to Frozen Strait, cannot have left any records on land until a party went ashore on Southampton Island, near Cape Comfort, on October 6, four months after leaving England. [59]

Thirdly, no record which was deposited by one or other of the explorers whose proceedings have been described, but was not mentioned in any of the available sources of information, seems ever to have been found, so far as the writer has been able to ascertain. Parties from the Franklin relief expeditions visited during the years 1851 to 1854 many of the places on Melville Island explored by Parry in 1819 and 1820, and these parties found no records which were not mentioned in at least one of the published narratives of Parry's first expedition. [60] Again, according to Parry's account of his third expedition, he left no records either at Port Neill or at Fury Beach or at any of the other places at which he and his officers landed on the shores of Prince Regent Inlet, and no records are said to have been found there either by John Ross in 1829, 1832, and 1833, or by the Franklin relief expeditions in 1849, 1851, and 1852. [61]

Negative evidence of this kind is obviously of very little value as regards places frequented either by Eskimos (who would have searched a white man's cairn for anything of value to them and would have thrown away a record had they found one) or by persons with no respect for memorials, but the following circumstances nevertheless deserve mention. The Swedish expedition to Spitsbergen in 1861 found that the copper plate fixed to a staff, left by Parry at Hecla Cove in 1827, had been wantonly destroyed, but a small depot, consisting of an ammunition chest marked "Hecla", was still intact under a heap of driftwood, and no record is said to have been found in it. [62] The American Arctic explorer Charles F. Hall went to Igloolik from his base at Repulse Bay in 1867, and again visited parts of Melville Peninsula in 1868. He found the remains of the cairn with flagstaff built for Franklin by Parry in 1823 opposite Igloolik, [63] and discovered at Lyon Inlet a cairn in which Parry had left a note for one of his officers, [64] but none of the many Eskimos whom he questioned told him of any other cairns that might have been built by Parry or by Parry's officers, [65] and the cairn which he found at "Parry Bay" (the "Franklin Bay" of modern charts) had no doubt been erected by Rae in 1847. [66] Again, the German expedition to East Greenland found no signs in 1869 of previous explorers on the island (one of the Pendulum Islands) on which Sabine had conducted some of his experiments in 1823. [67]

The available evidence thus seems to leave no room for doubt that the systematic marking of routes by means of records left on land was not carried out as a routine procedure by any of the commanders of Admiralty Arctic expeditions that sailed during the three decades preceding Franklin's last voyage. Moreover, the few commanders who were told to leave records or notices on land were instructed to do so only in certain localities. Until the Franklin expedition vanished, the possibility that an Admiralty Arctic expedition might fail to return evidently seemed much too remote to demand the issuing of orders to every commander to leave records on land at such frequent intervals that he could, if necessary, be followed successfully by another expedition sent to aid him. Not even the commanders of the first Franklin relief expeditions by sea had orders to mark their routes in this way, [68] and no such orders were issued by the Admiralty until April 11, 1850, when they were given to Captain Penny, commanding two ships sent in search of Franklin. [69] The records left by Beechey in 1826 and 1827 on the Alaskan coast did result in marking his route, but their purpose was not to do this but to leave information for Franklin. Lastly, on five of the six occasions on

which Parry deposited records on land during his voyage to Melville Island in 1819, and on every occasion on which Ross left records or notices on land during his voyage from Fury Beach to Felix Harbour in 1829, no progress was possible in ships, and so almost all the places at which these records were left were determined by unavoidable delay and therefore by chance rather than by design.

It is now necessary to consider how Franklin's actions with respect to leaving records on land during his last voyage would have been influenced by his orders and by established precedents. He was instructed to proceed through Lancaster Sound and Barrow Strait "without loss of time" and without examining any openings "either to the northward or southward in that Strait" until he reached the "longitude of that portion of land on which Cape Walker is situated, or about 98° West." He was then to sail southwards and westwards towards Bering Strait, and, if prevented from doing so "by ice of a permanent appearance", was authorised to seek a passage through the strait (Wellington Channel) "between Devon and Cornwallis Islands." He was told to throw overboard frequently records in copper cylinders or bottles after he had passed to the north of the 65th parallel of north latitude,[70] but was not ordered to leave records anywhere on land.[71] His instructions emphasised much more strongly than those given by the Admiralty to his predecessors sent in search of a North-West Passage,[72] that needless delay was to be avoided. Thus, while he was directed to ascertain the correct position of any points of land that he might pass, and to seize every opportunity of collecting and preserving zoological, botanical, and geological specimens, he was explicitly told that these duties were not to be allowed to cause his detention.[73] He would not, therefore, have been justified in stopping the ships for the sole purpose of leaving a record on land. He would, however, have been expected to deposit a record on newly discovered land when he took formal possession, and to leave a record at any harbour in which he spent a winter. Lastly, if his ships were unavoidably detained inshore, and a landing of some hours duration took place, he would propably, but not necessarily, have left a record.

His ships were seen for the last time by two whaling ships in the upper part of Baffin Bay at the end of July, 1845. He no doubt passed through Lancaster Sound and Barrow Strait as quickly as he could, in accordance with his orders, but must have been prevented from sailing southwards and westwards from the vicinity of Cape Walker, for he entered Wellington Channel. Parry had passed the southern entrance to this channel in 1819 and again in 1820 but had not entered it, and Franklin was the first explorer to sail into it. All his discoveries in Wellington Channel were consequently new, and the entire absence of signs of his having landed to take formal possession, suggests that the channel was open. The two records found on King William Island state that he turned back when he had reached the latitude of 77° North, but did not mention the longitude, and he may have been so far from land that no record could be left. He returned southwards not by the way he had come, between North Devon and Cornwallis Island, but between Cornwallis Island and Bathurst Island,[74] and, when he re-entered Barrow Strait was about 100 miles to the westward of Beechey Island. Nevertheless, he went there for the winter so is believed to have noticed before he sailed into Wellington Channel that the bay behind the island was well adapted as a winter station.[75]

There can be no doubt that Franklin, after wintering at Beechey Island, intended to leave a record there before he continued his voyage, and why no record could be found by the relief expeditions, in spite of repeated searches, is uncertain. M'Clintock believed that a favourable opportunity for leaving the island presented itself unexpectedly, and that Franklin's omission to leave a record was an oversight resulting from a hurried departure.[76] On the other hand, Sir John Richardson believed that a record was actually left, but, since no Eskimos lived at Beechey Island and there was consequently no need to conceal the record, this was placed in its metal case on top of the cairn, and Polar bears or wolverenes — with the habits of which he had become acquainted in Arctic Canada — had removed the record before the relief expeditions arrived.[77]

During the navigable season of 1846, Franklin sailed southwards, no doubt through Peel Sound and Franklin Strait, until on September 12 the ships were beset in ice in Victoria Strait, probably not far from the northern extremity of King William Island. That no records have been found on the shores of Peel Sound and Franklin Strait can again be fully explained by the supposition that

no landings took place, either because the channels were comparatively unobstructed by ice, or, if they were obstructed, because the ships were not detained inshore. The next winter (1846-7) was passed in the ice of Victoria Strait. In 1847 Lieutenant Gore of H.M.S. *Erebus* went to King William Island and deposited two records there. These can be regarded, and may have been intended, as the equivalents of the record which would ordinarily have been deposited on land at the place where the ships had wintered if this place had been a harbour. The ships remained beset, and after they had been abandoned, following a second winter passed in the ice in Victoria Strait, a second entry was made in April 1848 on one of the records deposited by Gore in 1847. This second entry is the last message ever received from the expedition.

In view of all the preceding considerations, Franklin cannot justifiably be blamed for having omitted to leave records on the shores past which he sailed, for this omission was neither exceptional nor contrary to his orders. As has already been mentioned, Sir John Richardson stated that "it was understood" that Franklin would "cause piles of stones or signal posts to be erected on conspicuous headlands at convenient times." If no "convenient times" arose, no records would have been left.

[1] M'Clintock, Sir F. Leopold. *The voyage of the Fox, etc.*, 5th. ed., London, 1881. pp. 244-47, 257, 258.

[2] Hobson in May 1859, before the snow had melted, did not notice a cairn between Wall Bay and Cape Felix, King William Island. This cairn, evidently built by the Franklin expedition, was found by Schwatka in July 1879, after the snow had melted. It contained a paper bearing in pencil the representation of a hand with pointing finger; the bottom of the paper had rotted away. W. H. Gilder, *Schwatka's Search*, n.d. (1881), p. 147; H. W. Klutschak, *Als Eskimo unter den Eskimos*, Vienna, etc., 1881, p. 101 and map opp. p. 112.

[3] Houston Stewart Island and Milne Island, both in Queen's Channel, are examples. They may have been visited by Franklin in 1845 but were not examined by the relief expeditions.

[4] *Parliamentary Paper*, Copies of instructions to Captain Sir John Franklin etc., London, 1848, p. 23. Further references to *Parliamentary Papers* are given as *P.P.*

[5] *P.P.*, Copies of any reports or statements from the officers employed in the Arctic expedition, London, 1850, p. 109.

[6] *Arctic searching expedition*, 2 vols., London, 1851, Vol. 1, p. 2.

[7] Instructions to Captain H. T. Austin, P.P., *Arctic expeditions. Report of the Committee, etc.*, London, 1851, p. 150.

[8] *Idem*, pp. 157, 180.

[9] *Life of Sir John Franklin*, London, n.d. (1891), p. 248.

[10] Ross, Sir John. *A voyage of discovery, made under the orders of the Admiralty, etc.*, London, 1819, pp. 1-14.

[11] Probably the Duck Islands.

[12] Armstrong, A. *A personal narrative of the discovery of the North-West Passage*, London, 1857, pp. 209, 252, 255.

[13] Ross, Sir John. *op. cit.*, pp. 58, 59, 67, 69, 79, 137, 138, 139, 177-181, 198, and chart opp. p. 116; Anonymous, *An officer of the Alexander*, actually A. Fisher, *Journal of a voyage of discovery to the Arctic regions*, London, n.d. (1819), pp. 37-39, 48, 53, 62-64, 74-76, 79, 80.

[14] Admiralty Records, Public Record Office, Log of H.M.S. *Isabella*, John Ross, A.D. 55/81; Log of H.M.S. *Alexander*, W. E. Parry, A.D. 55/3. Further references to the Admiralty Records are given as A.R.

[15] Beechey, F. W. *A voyage of discovery towards the North Pole*, etc., London, 1843, pp. 6-22.

[16] *Idem*, pp. 44-60, 98-104, 128-158, 187, 188; A. R. Logs of the *Dorothea*, A. Morell, A.D. 55/36, and P. Bruce, A.D. 55/37; and of the *Trent*, F. W. Beechey, A.D. 55/139, and G. Back, A.D. 55/138.

[17] Parry, Sir W. Edward. *Journal of a voyage for the discovery of a North-West Passage*, London, 1821, pp. XIX-XXIX.

[18] *Idem*, pp. 27, 38, 39, 45, 69, 76; A. Fisher, *A journal of a voyage of discovery to the Arctic regions*, London, 1821, pp. 64, 75-77, 90, 101-104, 115; Anonymous, (probably W. N. Griffiths, Midshipman, H.M.S. *Griper*) *Letters written during the late voyage of discovery in the western Arctic sea*, London, 1821, pp. 23, 30, 32, 36, 39.

[19] Parry's narrative did not mention that this record was deposited on taking formal possession, but the record itself, found by M'Clintock in 1851, did say so. *P.P.*, "Additional papers relative to the Arctic expedition, etc.," London, 1851, p. 175.

[20] Parry, Sir W. Edward. *op. cit.*, pp. 189, 193, 194, 204; A. Fisher, *op. cit.*, 1821, pp. 198, 203, 206, 212, 213, 221 (footnote), 229.

[21] Parry, Sir W. Edward. *op. cit.*, pp. 96, 97, and chart opp. p. 226; A. Fisher, *op. cit.*, 1821, 229 (footnote), 238, 239.

[22] Parry, Sir W. Edward. *op. cit.*, pp. 228-269, 272-274, 278-296.

[23] The log books and journals contain scarcely any mention of the leaving of records and add nothing to the information contained in the published narratives. A.R. Log of the *Hecla*. W. E. Parry, A.D. 55/60; Log of the *Hecla*, F. W. Beechey, A.D. 55/61; Log of the *Griper*, M. Liddon, A.D. 55/57; Log of the *Griper*, H. P. Hoppner, A.D. 55/58; The Private Journal of Lieut. M. Liddon, A.D. 55/59.

[24] Parry, Sir W. Edward. *Journal of a second voyage for the discovery of a North-West Passage*, London, 1824, pp. XXI-XXX.

[25] *Idem*, pp. 17-19, 34, 35, 38-40, 41, 42, 44-48, 50-118; G. F. Lyon, *The private journal of Captain G. F. Lyon*, London, 1825, pp. 32, 33, 43, 45-47, 48-50, 52-86.

[26] Parry, Sir W. Edward *op. cit.*, 1824, pp. 229-234, and chapters 10-15 incl.; G. F. Lyon, *op. cit.*, pp. 191-199, 207, 416-425.

[27] Parry, Sir W. Edward. *op. cit.*, 1824, p. 474; G. F. Lyon, *op. cit.*, p. 445.

[28] Parry, Sir W. Edward. *op. cit.*, pp. 476, 478.

[29] There appears to be no mention of the deposition of records in the principal log books. A.R., Log of the *Fury*, Sir W. Edward Parry, A.D. 55/55; Log of the *Hecla*, G. F. Lyon, A.D. 55/62; Log of the *Hecla*, H. P. Hoppner, A.D. 55/64.

[30] Clavering, D. C. Journal of a voyage to Spitsbergen etc., in *The Edinburgh New Philosophical Journal*, Edinburgh, 1830; E. Sabine, *An account of experiments to determine the configuration of the earth*, London, 1825, pp. 131-181; A.R., Log of the H.M.S. *Griper*, D. C. Clavering, A.D. 51/3188.

[31] Lyon, G. F. *A brief narrative of an unsuccessful attempt to reach Repulse Bay*, London, 1825, pp. IX-XVI.

[32] Coats Island is not named on Lyon's chart, *op. cit.* opp. p. 1. He believed that it was part of Southampton Island, the boundaries of which were not fully known.

[33] Lyon, G. F. *op. cit.*, 1825, pp. 49-52, 54-64, 66-70, 87-89, 94-96; A.R., Log of H.M.S. *Griper*, G. F. Lyon, A.D. 51/3188.

[34] Parry, Sir W. Edward. *Journal of a third voyage for the discovery of a North-West Passage*, London, 1826, pp. XVII-XXVIII.

[35] *Idem*, pp. 22, 23, 28.

[36] Markham, Sir Clements R. *Life of Admiral Sir Leopold M'Clintock*, London, 1909, p. 55.

[37] Parry, Sir W. Edward. *op. cit.*, 1826, pp. 82-85, 99, 100, 102, 103-105, 156-161.

[38] The log books appear to make no mention of the landing of parties for the purpose of depositing records. A.R., Sir Edward Parry's manuscript Journal, A.D. 55/67; Log of the *Fury*, H. T. Austin, A.D. 55/56, (continued on the *Hecla* after the *Fury* had been abandoned).

[39] Beechey, F. W. *Narrative of a voyage to the Pacific and Beering's Strait*, New ed. 2 vols., London, 1831, Vol. I, pp. VIII-XV, 326.

[40] *Idem*, Vol. I, pp. 350, 357, 363, 369, 373, 374, 388, 419, 420, 462, 463, and picture opp. p. 462.

[41] *Idem*, Vol. II, pp. 260, 276, 290.

[42] Parry, Sir W. Edward. *Narrative of an attempt to reach the North Pole*, London, 1828, pp. XIX-XXII.

[43] *Idem*, pp. 19, 25, 31-34, 46, 47, 48, 50-54, 119-127, 132, 133, 134, 138 and chart opp. p. 134; R. M'Cormick, *Voyages of discovery in the Arctic and Antarctic seas, etc.*, 2 vols. London, 1884, Vol. 1, pp. 388, 389, 394, 396, 397, 399, 400-414; A.R., Official Journal, W. Edward Parry, A.D. 55/71; Log of the *Hecla*, F. R. M. Crozier, A.D. 55/69; Log of the *Hecla*, J. Weir, A.D. 55/68.

[44] Ross, Sir John. *Narrative of a second voyage in search of a North-West Passage*, London, 1835, pp. 107-112, 116-118, 130-133, 156-159, 163, 171-173.

[45] *Idem*, pp. 142-147, 148, 151-154, 155.

[46] *Idem*, pp. 315, 409, 418, 557, 560.

[47] *Idem*, pp. 656, 667, 716, 717, 724, 725.

[48] Back, Sir George. *Narrative of an expedition in H.M.S. Terror*, London, 1838, pp. 6-15.

[49] *Idem*, pp. 119-121, 130-132, 141, 143, 144, 145, 146, 165, 166, 188-190, 191-194, 195, 196.

[50] A.R. A.D. 55/132.

[51] *P.P.*, Arctic expeditions. Report of the Committee, etc., London, 1851, p. 93.

[52] Parry, Sir W. Edward. *op. cit.*, 1821, pp. 198, 199. Parry mentioned this record in his private journal but not in his published narrative. W. H. Hooper, Manuscript Diary of this expedition, part 2, p. 142, Library of the Royal Geographical Society.

[53] Fisher, A. *op. cit.*, 1821, pp. 218-221, and footnote on p. 221; *P.P.* Additional papers relative to the Arctic expedition, etc., London, 1851, p. 171.

[54] Parry, Sir W. Edward. *op. cit.*, pp. 189, 193, 194, 204; A. Fisher, *op. cit.*, 1821, pp. 198, 199, 203, 206, 212, 213, footnote on p. 221, p. 229 and footnote on same page. After the party had returned to the ship, a second record in a cylinder was placed in the cairn built on Table Hill, near Winter Harbour, during the land journey. The first record, left in the cairn when this was erected, was apparently intended to be only a makeshift.

[55] Parry, Sir W. Edward. *op. cit.*, 1821, pp. 68, 69; *P.P.* Additional papers relative to the Arctic expedition, etc., London, 1851, p. 156.

[56] Bellot, J. R. *Memoirs of Lieutenant Joseph René Bellot*, 2 vols., London, 1855, Vol. I, pp. 309-313, 317.

[57] Parry, Sir W. Edward. *op. cit.*, 1821, pp. 46-60 and chart opp. p. 29. A party landed at Cape Riley, North Devon, on August 22, 1819, but was recalled in 10 minutes. *P.P.* Copy or extracts from any correspondence or proceedings of the Board of Admiralty in relation to the Arctic expeditions, London, 1851, pp. 71, 72.

[58] Parry, Sir W. Edward. *op. cit.*, 1821, pp. 258-272.

[59] Back, Sir George. *op. cit.*, 1838, pp. 17-121.

[60] Armstrong, A. *op. cit.*, London, 1857, pp. 513, 515-520; S. Osborn, *The discovery of the North-West Passage by H.M.S. Investigator*, etc., London, 1856, pp. 234, 235; G. F. M'Dougall, *The eventful voyage of H.M. Discovery Ship Resolute*, London, 1857, pp. 252-263; R. Collinson, *Journal of H.M.S. Enterprise*, London, 1889, pp. 212, 213; *P.P.*, Further papers relative to the recent Arctic expeditions, London, 1855, pp. 409-732 (full account of the proceedings of all the parties which from the ships commanded by Captain Kellett during the years 1852, 53 and 54, visited places on Melville Island previously visited by Parry and his officers). See also J. E. Bernier, *Report on the Dominion of Canada Government expedition to the Arctic islands and Hudson Strait, etc.*, 1908-09, Ottawa, 1910, pp. 62, 102, 103, 227, 228, 353 et seq.

[61] Ross, Sir John. *op. cit.*, 1835, pp. 107-112, 656-679, 698-716; *P.P.*, Copies of any reports or statements from the officers employed in the Arctic expedition, London, 1850, pp. 58-64; J. D. Gilpin, *Outline of the voyage of H.M. Ships Enterprise and Investigator, The Nautical Magazine*, London, 1850, pp. 8-19, 82-90, 160-170, 230; J. P. Cheyne, Voyage of H.M. ship *Enterprise*, Sir Jas. Ross, 1848-9, *Finsbury Park Monthly Illustrated Journal*, Vol. 1, London, 1873; W. Kennedy, *A short narrative of the second voyage of the Prince Albert, etc.*, London, 1853, pp. 58, 59, 73-81, 95-112, 151-152, 159-161.

[62] Chydenius, K. *Svenska expeditionen till Spietsbergen, etc.*, Stockholm, 1865, pp. 82, 83, 208, 209.

[63] Nourse, J. E. *Narrative of the second Arctic expedition made by Charles F. Hall*, Washington, 1879, pp. 305, 306.

[64] *Idem*, p. 364; Sir W. Edward Parry, *op. cit.*, 1824, pp. 86, 87.

[65] Nourse, J. E. *op. cit.*, pp. 295-309, 331-358, 596-605.

[66] *Idem*, pp. 344-348; *John Rae's correspondence with the Hudson's Bay Company on Arctic exploration, 1844-1855*, edited by E. E. Rich and A. M. Johnson, London, 1953, pp. XXXI-XXXV of the Introduction (by J. M. Wordie and R. J. Cyriax); R. J. Cyriax, Captain Hall and the so-called survivors of the Franklin expedition, *The Polar Record*, Cambridge, July 1944.

[67] *Die zweite Deutsche Nordpolarfahrt in den Jahren 1869-70 unter Führung des Kapitän Karl Koldewey*, Vol. I, Leipsic, 1874, footnote on pp. 314, 315.

[68] (i) Commander Moore, (ii) Captain Kellett (auxiliary to Moore), (iii) Sir James Clark Ross, (iv) Captain Collinson. For their orders, see (i) *P.P.*, Copies of instructions to Captain Sir John Franklin, etc., London, 1848, pp. 7-9, 10, 11. (ii) *Idem*, pp. 16-18. (iii) *P.P.*, A copy of the orders.... under which Captain Sir James Clark Ross, R.N., has proceeded on an expedition in search of Captain Sir John Franklin, R.N., London, 1848. (iv) *P.P.*, Copies of any reports or statements from the officers employed in the Arctic expedition, etc., London, 1850, pp. 82-85.

[69] *P.P.*, Arctic expeditions. Report of the Committee, etc., London, 1851, pp. 150-152.

[70] Only one of these records was recovered. It is dated June 30, 1845, and was found four years later on the west coast of Greenland. It gave no fresh information since news of later date had already been received. The original is in A.R., *Arctic expeditions, 1849-50*. See also R. J. Cyriax, *Sir John Franklin's last Arctic expedition*, London, 1939, pp. 59-61.

[71] *P.P.*, Copies of instructions to Captain Sir John Franklin, London, 1848, pp. 3-7.

[72] Compare Franklin's orders with those given to John Ross in 1818, and to Parry in 1819, 1821, and 1824, *loc. cit.*

[73] Franklin's orders, sections 18 and 20, *loc. cit.*

[74] An island, Little Cornwallis Island, lies between Cornwallis Island and Bathurst Island. Whether Franklin sailed southwards on the east or on the west side of Little Cornwallis Island is not known.

[75] Richardson, Sir John. *The Polar Regions*, Edinburgh, 1861, p. 162; Sir Albert H. Markham, *op. cit.*, p. 210.

[76] *P.P.*, Arctic expeditions. Report of the Committee, etc., London, 1851, p. 93. (See also pp. 28, 50, 90).

[77] *Idem*, p. 177; Sir John Richardson, *op. cit.*, 1851, Vol. II, pp. 419-421; *op. cit.*, 1861, p. 163.

Plate 1. *(over)* The upper object is the underside of the hanging-bowl with escutcheon plates to carry the supports. The thin repair plate in the centre is probably the oldest piece of craftsmanship and bears a characteristic threefold trumpet design; this escutcheon replaces one which had been lost before the bowl was out of use. The two lower objects are of unknown use but resemble scabbard chapes.

Plate 2. *(above)* Escutcheon plate inside one bowl with human masks at apices of triangles and blood-red enamel in centre.

Plate 3. The largest brooch with the finest workmanship of the twelve. The 'jewels' are missing but traces of malachite and pearl-shell were found in the sockets. The pin had been largely corroded to dust.

Plate 4. Two brooches as cleaned. The upper is the more normal type of design. The lower has its terminals shaped as animal heads with bared teeth and inset 'jewels' for eyes.

All photographs by A. Cain, Department of Anatomy, University of Aberdeen.

EXCAVATIONS AT ST NINIAN'S ISLE

A. C. O'DELL

ST Ninian's Isle is situated off the west coast of the southern part of the Mainland of the Shetland Islands and is now joined to it by a long tombolo beach of gleaming white sand. In stormy weather the isle is cut off from the Mainland for days together and this is said to be the reason why the graveyard was abandoned about a hundred years ago. Rising steeply from the sea the site is most inviting and has much which would have attracted early settlers – the isolation for meditation, the perennial well of clear water and the green meadows. There are marked resemblances with Whithorn where St Ninian founded his church *c.*397.

According to Bede, Ninian, a native of the Solway region, received his religious education in Rome at a time when organised Christianity was taking shape. It is possible that Augustine and Ninian were both students in Rome at the same time and received together the inspiration to convert the tribes in Britain. Early writers have stated that Ninian went to St Martin at Tours and there is no doubt that similarities can be traced with that religious foundation and *Candida Casa* at Whithorn including the use of whitened plaster on the outside of the walls.

It was the custom of the Celtic missionaries to name their foundations after their teachers, therefore the string of Ninianic dedications in or at, *inter alia*, Bute, Stirling, Abirlot, Dunottar, Methlick, Glenurquhart, Navidale, Wick, Orkney and Shetland implies a movement of disciples, and not Ninian himself, on evangelical tours north-east from Galloway. One of these evangelists could well have been attracted to St Ninian's Isle by the similarities with a beloved Whithorn.

In June, 1955, students drawn mainly from Aberdeen University Geographical Society, under my direction, commenced excavations at St Ninian's Isle in order to locate the lost church dedicated to the saint. It was known that a medieval church had stood here until about 1750 when it was said to have been demolished to provide stone for a dyke across the island approaches. Tradition had it that the building was barrel-vaulted and that the steeple for this building was across the bay at Ireland (Ayreland). Brand, who visited the church about fifty years before its demolition wrote: "To the northwest of the Ness lyes St Ninian's Isle, very pleasant; whereon some superstitious people do burn candles to this day". A Shetland antiquarian found in 1875 some ogam-inscribed stones at the site, which indicated a Celtic connection, but was unable to locate the medieval structure which he believed had been totally destroyed. Revival of interest came at the first Viking Congress held in Lerwick in 1950 when Dr W. Douglas Simpson first drew attention to similarities of the site with that at Whithorn and this suggestion culminated in the field project in 1955. The landowner, Mr James Budge, gave permission for the excavation to be carried out although all that was anticipated was the location of earth-fast foundation stones.

Realisation far outstripped expectation: the curved apse and altar were uncovered in 1955, the nave and outer walls cleared 1956-7. Trial pits sunk in 1957-8, both within and without the medieval walls, have revealed an underlying Iron Age complex. The whole of the area has been widely used for at least 1,500 years as a burial ground. The church measures overall 50 by 23 feet and consists of a nearly rectangular nave for two-thirds if its length with a curved apse at the eastern end. The walls average 3 feet 2 inches in thickness but attain 5 feet 4 inches at the eastern angles of the apse. The foundation courses of the chancel arch only remain on the southern side, while where they were expected to be found on the north preliminary exploration suggests that there may have originally been a void, such as a small crypt, for there is a mass of fallen stones with air-spaces between them. Portions of the medieval walls still stand some four feet high and the whole has been constructed with lime-mortar from burnt shells. Inside and out the church had been covered with lime plaster which suggests the tradition of Whithorn. Immediately to the south east of the apse is a drystone enclosure into which Mr Ralegh Radford advised investigation: by analogy with Irish examples this became known as the 'Founder's Tomb' and may well be equivalent with a shrine.

Medieval finds include fragments of igneous slabs into which have been hewn crosses. An inscribed cross on a sandstone block, attributed to the eleventh century, has been re-erected in the local Bigton church in the custody of the Church of Scotland. In 1957 a trench was cut across the eastern part of the nave to try to find traces of a pre-medieval structure. So far no traces have been found of Celtic walls but a noteworthy find was a small polished fragment of *Porfido verde antico*, a stone quarried in Egypt and Greece and used to decorate buildings in ancient Rome. Stone stripped from the pagan temples later decorated Christian churches in the Eternal City. How came this fragment to the Shetland Islands? Was it part of a reliquary box of the medieval period or a casual fragment brought by a pilgrim?

Within the 'Founder's Tomb' were found in 1957 seven grooved stones of which four were carved with hippocamp and other symbols characteristic of Pictish art. These grooved pillar stones were found in positions which showed thay had been re-used and originally they must have supported panel stones such as that from Papil, now preserved in the County Offices in Lerwick where the St Ninian's set have also been deposited for preservation.

Trowelling within the nave had been in progress for some weeks in 1958 below the level of the medieval foundations when on the 4th of July a thin slab of sandstone with a lightly inscribed cross was found. Below this were the rotted remains of a larch box and a collection of 28 examples of metalwork, weighing 61ozs Troy, all brightly incrusted with copper. A copper-stained reliquary bone has been identified as the jawbone of a porpoise and suggests that perhaps it was church treasure which was buried for safety although not all the metalwork can be identified as ecclesiastical. Between the Pictish Christian symbol stones, in their re-used position, was a pagan internment with above and below extended burials. May both this pagan burial and

the cache be explained by the arrival of Norse peasants here about 800 A.D.?

The metalwork was found in a tangled group and was so delicate with corrosion that it was removed south to the only laboratory in the country which is equipped and staffed for such specialised conservation work. Dr Harold Plenderleith of the British Museum Laboratory immediately undertook cleaning and preservation. All the metalwork was of silver, though some was of an inferior quality from which the copper has been dissolved leaving a porous, spongy base. Many of the objects had been gilded and this had helped to preserve the design and form but even in these cases the material will have to be kept in future in a damp-free atmosphere with silica gel to prevent moisture starting afresh the cycle of chemical decay. (See Plates 1–4).

From the moment the cache was found it was clear that the work was Celtic in type, but on searching the records of known objects no close parallels were found. Twelve brooches were in the hoard and each has a distinctive design. Similar brooches to these are preserved in Dublin and the one with the greatest resemblance was found in Antrim and is attributed to 820 A.D. All the surviving brooch pins have kinks in them resulting from use. Seven bowls were found and these again have differing designs ranging from geometrical to cursive animal patterns in punchwork.

One object in a particularly delicate state was the hanging bowl and it was only when it was identified as being of silver that it was decided to do more than neutralise decay. One other silver hanging bowl was found in Britain but, since its discovery in the eighteenth century, it has disappeared. Many bronze hanging bowls have been discovered in England but only the fragments of two in Scotland, so both from its material and as an object it is a particularly valuable addition to the Scottish list of finds. This hanging bowl and one of the other bowls have handsome escutcheon plates in gilt and the designs on these offer possibilities of identificaton of the provenance of manufacture.

There have been many conjectures about two handle-like objects which have a narrow slot on the inner edge as if a fabric – or very thin leather – had been inserted. The most likely use is that they were belt or stole ends. One bears an inscription on both sides which, although it is definitely ecclesiastical, is still exercising the philologists as to the exact transliteration and translation. Three cone-shaped items, much rubbed at the tips, have no parallels and it has been suggested that these may have been belt ornaments. In the Laboratory two rods were cleaned and by fitting rivet holes together one has been reassembled as a shallow spoon which, from analogies with the ritual of the Greek Orthodox Church, may well be a communion spoon.

The likeness to the design of the Lindisfarne Gospel ornamentation at once suggests a provenance. It is now considered likely that the metalwork from St Ninian's Isle had been manufactured in the cultural province which extended from northern Ireland across southern Scotland to Northumbria and one art historian has suggested that the craftsmen may have dwelt in Old Melrose.

TROUBLE WITH THE REGIONS — PLANNING PROBLEMS IN RUSSIA

Marshal Bulganin's words that "the correct geographical distribution of the productive forces is fundamental for the new and mighty advance of the Soviet economy" may be linked to a reappraisal of Soviet ideas on economic regionalisation *(ekonomicheskoye rayonirovaniye)* carried out since the death of Stalin. [1] The change is linked to the names of several eminent Soviet economic geographers, who have reflected their ideas in recent textbooks for teachers. [2] Despite all the the attention given to the delineation of administrative boundaries, no really satisfactory formula seems yet to have been evolved to define the major economic regions used for statistical and planning purposes.

Recent American studies have traced the evolution of the Soviet administrative pattern up to 1946, but none has examined the new lines of thought since Stalin's death. [3] Since the reduction in status of the Karelo-Finnish S.S.R., the U.S.S.R. is composed of fifteen union republics, some of the larger ones containing smaller autonomous or semi-autonomous national-political units. The larger republics are divided into *oblasts* and the more subservient *rayons*. This two-tier pattern is closely related to economic-geographical development. In the R.S.F.S.R., the *oblasts* and their equivalents are grouped to form major economic regions, while the other union republics are grouped together for similar statistical and planning purposes. At each stage of the hierarchy, the units are designed to have an industrial settlement as their centre (workers' settlement or town, according to rank), from which are supposed to spread current ideas and the tempo of economic development to the remaining area of the unit which serves as its hinterland. By developing a varied economy, each unit tries to cover as many needs of its centre as possible, thus creating a measure of self-sufficiency. This is to reduce the burden on transport and to prevent a "dangerous concentration of particular activities", such as characterised Tsarist Russia. The units, nevertheless, aim at developing specialisations to fit into the "all-union" pattern of the economy, which may seem superficially to the Western mind a contradiction.

The origin of the major economic regions lies in the basic principles evolved by the Kalinin Commission of 1921-22 in seeking to formulate major electric power generation districts for the State Electrification Plan *(GOELRO)*. Four principles, based on Marxist-Leninist dogma, were proposed: first, the *principle of perspective* regards not only present conditions but also long-term plans; the second, that of *energy*, is to develop local resources (particularly fuel minerals) to the highest degree by the most modern and efficient means; while the third, that of the *complex economy*, and the fourth, that of *specialisation*, aim at the creation of a diverse, largely self-sufficient economy with specialisations fitting into the national pattern. No boundaries, however, may cut across those of the national-political units. On these principles, a division was proposed, [3] but it did not find acceptance as it failed to respect completely the integrity of certain republic boundaries. Contraventions of the integrity of republic boundaries, stressed by Lenin, were the linking of the Ukrainian and Great Russian parts of the Donbass, the incorporation into the Western district of the R.S.F.S.R. of the then small Byelorussian district, and the amalgamation of the Caucasian republics with North Caucasia. The formation of the Vyatka-Vetluga district (upper Volga) was also criticized because it lay adjacent to the highly developed Central Industrial Region and did not have a "proletarian centre" around which to develop its economy. Nevertheless the administrative pattern of the middle thirties bore a strong likeness to the suggestion by Gosplan, until the extensive reorganisation of 1937 onwards.

In the Third Five Year Plan, a new conception of economic regionalisation, the *makrorayon*, was introduced, bearing some of the Stalinist ideas later to be dominant. The theory, enunciated first by economists for the 1939 session of the Communist Party, aimed at maximum self-sufficiency within fewer and much larger major regions, designed primarily to reduce the mounting burden on transport. Apart from strategic attractions, the new system is now considered to have few virtues. After the interruption of the war period, a new division into thirteen major economic regions was announced in 1946.

Although Gosplan has only said that the "principles of the complex economy and specialisation" were applied to define the new regions, Soviet geographers think that they are substantially influenced by the *makrorayon* theory. If this is the case, then nothing fundamentally new has been added to the original theory. [4]

A statement by Gosplan that certain districts without strongly marked characteristics have gravitated towards regional centres in a somewhat arbitrary way and without any loss to the national welfare is strongly condemned. The new school is emphatic that every district has clear affinities to a particular centre, conditioned by its economy and in no small measure by transport patterns. For example, it is impossible to detach Kirov *oblast* from the Centre and attach it to the Ural without substantial alternations in transport flows. More numerous regions, Gosplan claims, would unduly complicate statistical and fiscal records: the new school suggests that important differences in the pattern of economy and development are concealed by the present small number of regions. At present, there is duplication of effort by insisting on self-sufficiency; this could be eliminated by careful inter-regional co-ordination. There is need for more careful location of industrial plants in relation to power supplies, raw materials, markets, and minimum demands on transport, to be obtained by more skilfully planned combines and further rationalisation of inter- and intra-regional traffic flows. Much arises from the failure to reflect accurately fiscal and statistical development of "objectively existing or planned productive projects", because of the inadequately representative economic regionalisation. This has been revealed by the unequal attention to expansion shown by studies of the Molotov and Irkutsk districts and in the Yakut A.S.S.R. [5]

Difficulty has been caused by the rapid wartime expansion of the Volga lands, the Urals, and Western Siberia, to the neglect of areas further east. Some of the newer territories (e.g. Tuva A.O., the Baltic republics) have not yet been adequately incorporated into the national economy. The associations and orientation of these new territories must be carefully considered in relation to existing regionalisation. The Soviet writers maintain that the fundamental failure has been to ignore "geographical realities". Pre-war ideas divided the country into 10-15 major regions which were to be self-sufficient. This ideal is unattainable: natural resources, notably power minerals, are unequally distributed. No one region has in adequate quantity and quality all the 1,500 or more substances needed to feed modern industry. Even the Urals which come nearest to the ideal are deficient in coking coal and certain non-ferrous metals. The Volga lacks metallic minerals and coal, though it has adequate supplies of oil and water power. The Centre, the major manufacturing region, lacks many important power and other minarals. Siberia is deficient in foodstuffs, as are the Central Asian republics which specialise in technical crops not otherwise possible within the U.S.S.R.

The steady rise in transport demands since 1945 makes examination of present traffic flows urgent. Railway traffics need special attention since railways still handle over 80 percent of all goods and passengers while average length of haul and the ton-km per head of population have increased markedly. [6] The bulk of circulation is over the routes European Russia-Urals-Kuzbass-Central Asia, where many cross flows occur. In 1954, Kaganovich claimed that 13 million tons of coal were wastefully hauled at a cost to the national economy of 4 million tons of fuel and 350 million roubles; additionally, 4.6 million tons of petroleum and allied products, 4.5 million tons of wood, 1.8 million tons of wheat, and 1.5 million tons of iron and steel were unnecessarily moved. Total wasteful haulage amounted to 50 million tons of goods at a cost of 2,000 million roubles. Wasteful hauls have included sending vegetables from the Volga to the Far East (refrigerator cars run 48 per cent of their mileage empty), and the repair of motor cars from the Far East at Ivanovo in European Russia. The latter cost averages 12,500 roubles (c.i.f.), but a new car delivered to the Far East costs only 13,700 roubles. Since coal forms 27 per cent and petroleum goods 10 per cent of the annual revenue ton-kilometres on the railways, great economies could be achieved by better definition of the economic regions in relation to power generating resources. With increased output from the mines of Itat, Cheremkhovo, and Chulman in Siberia, this is an important problem. Careful planning of delivery of Kuzbass and Donbass coals could reduce much of the present overlap in the Volga region. Plant location is also a factor: a "rational" location is that of the Cherepovets iron and steel works, based on Vorkuta coal, Karelian iron ore (Gimoly, Pudozhgora), and the markets of Leningrad, Arkhangelsk, and the Centre. "Irrational" location and working is illustrated by the use at Novosibirsk of metal from Novo-Tagil and Chelyabinsk, 1,670km away; some of this metal has already

been sent 2,000km to Novo-Tagil from the Kuzbass Metallurgical Combine for preparatory working. Russian sources stress the need to locate iron and steel manufacture near raw materials, since about 7.5 million tons of raw material are needed to produce 1.5 million tons of metal. [7]

The problems raised by the division into thirteen regions are: the division of Siberia, the division of the Centre, and the grouping of the republics. Failing some new and valid division, Russian experts agree that the principles defined in 1921 ought to be used. The unit *Kazakhstan-with-Central Asia* is considered too diverse and likely to lead to unnecessary transport needs. Kazakhstan, with an area of 2.74 million ha, specialises in non-ferrous metals, coal, and grains, and can be subdivided into Northern Kazakhstan (grain and non-ferrous metals), Central Kazakhstan (coal and non-ferrous metals), and Southern Kazakhstan (irrigation crops). The Central Asia republics are primarily producers of technical and other irrigation crops. The flow of traffic from Kazakhstan is primarily to the metallurgical bases in the Urals and Kuzbass. This northerly bias will increase with growing output of metals and coal and increasing food consumption in the Siberian cities. The relations of the Central Asian republics are more to the Volga and the Centre, a trend which will strengthen after completion of the Kungrad-Makat-(Aleksandrov Gay) railway.

Although adequate until recently, the two-fold division of Siberia does not reflect development planned for this territory in the current Five Year Plan. The original Gosplan division into five regions would now better reflect the Siberian economy. Expansion is at present in the Kuznetsk-Altay, Lena-Baykal, and in Yakutia. In the Kuznetsk-Altay, the present Plan will expand coal and iron ore output and start the erection of a major West Siberian Iron and Steel Combine near Stalinsk. The Lena-Baykal area, besides increasing output of coal, will also become a major producer of hydro-electric power from the Angara "cascade". Yakutia is to be developed in future plans, but a start has been made by opening up the Chulman coals, which will form a base, along with Rudnogorsk and Tolba iron ore, for a Yakut Iron and Steel Combine. Yakutia will also be a major supplier of precious metals and diamonds. Expansion is also planned for agriculture in the Lena-Vilyuy plain and for salt mining at Olekminsk. Creation of separate units for the Ob and Yenisey would doubtless accelerate development of their latent if somewhat limited resources.

The suggested subdivision of the Centre is again a return to original Gosplan ideas. It is easily one of of the most important regions, having 25 per cent of the Soviet population living on 5 per cent of the area of the U.S.S.R., and producing a substantial contribution to industrial output. The original division of the Central Industrial, Central Black Earth, Vyatka-Vetluga, and West regions, was later, with the rise in status of Byelorussia, changed to a Central Black Earth-with-West region and a Central Industrial region. Vyatka-Vetluga was transferred to the Volga region, but was later returned to the Centre. Considered as a unit, the Centre is an attempt to create a diverse (complex) economy by linking the manufacturing industry of the Central Industrial districts to the agricultural and mineral resources of the Central Black Earth region. The criticism is that such a union conceals the true nature of the Black Earth districts, which are to undergo transformation in the Sixth Five Year Plan, by extensive modernisation programmes in agriculture, increased iron output from the ores of the Kursk Magnetic Anomaly, and augmented by electric power from the great Lower Volga power station at Stalingrad. The extensive reorganisation in the Black Earth districts was reflected in the creation of new *oblasts* around the centres of Belgorod, Balashov, and the metallurgical town of Lipetsk.

Criticism of the grouping together of the Ukraine and Moldavia is based primarily on a belief that the larger republic would overshadow the smaller, failing to reflect Moldavian achievements in published figures. Intensified development also warrants the sub-division of the Ukraine. Division into a Southern Mining Region, West Ukraine, Central Ukraine (a growing metallurgical and electric power generation centre), and the Black Sea Littoral, is more far-reaching than the 1921 ideas of the Kalinin Commission. Attachment of the Crimea (formerly in the North Caucasian Region) to the Ukraine in 1954 is welcomed on economic and historical grounds. It is suggested that since completion of the Don-Volga Canal there is a case for the union of the North Caucasus with the Lower Volga into a single region.

Objections on historical and economic grounds to the grouping of Byelorussia and the Baltic republics seem misplaced to the Western mind. The internal orientation of the U.S.S.R. is perhaps reflected in this belief which ignores the relation of the Byelorussian districts to the formerly great Baltic ports (e.g. Königsberg, Memel, Riga etc). The grouping together of the Caucasian republics is hailed as not "an arbitrary association". Little has been said about the reduction of the Karelo-Finnish S.S.R. to an autonomous S.S.R. within the R.S.F.S.R. The recent greatly increased exploitation of timber and ore resources has doubtless drawn in large numbers of Slavonic Russian workers, making it desirable to draw the area into closer association with Moscow. The changed Russo-Finnish relations have perhaps also been a not inconsiderable factor.

Changes in Russian thoughts on regional planning have swung back in favour of the smaller unit. The thirteen major regions described above have not been abandoned: they remain for broad and long-term national planning; but a long-felt desire for a closer liaison between the economic regions and the territorial-administrative regions has been realised. Following the reorganisation of the economy in 1956 and 1957 under the leadership of Mr Khrushchev, a new regional economic commission, the *Sovnarkhoz*, has been created.[8] Formerly, the administrative-territorial units at *oblast* level only exercised control over agriculture and industries of local importance. Major industrial undertakings of national significance were under their respective ministerial control. Now the 105 *Sovnarkhoz* regions enjoy their own planning and budgetary responsibilities, which it is thought will lead to greater efficiency, more rational and more elastic development of resources, both at a local and national level. The principles for development remain, however, fundamentally unchanged from those outlined in the early part of this paper: the simultaneous growth of local specialisms and a "complex" economy. As already noted, the new regions have their centres at large industrial towns, to which their whole economy gravitates.[9]

So far the boundaries of the new regions appear to be fluid. The new boundaries and units have been apparently formed partly out of directives from the Gosplan authorities, partly from the pressure of local feeling. Early reports suggested that some difficulty had been experienced in preventing the formation of unworkable regions by local people which would not fit into the national pattern. The size of the regions varies greatly, from the small Kabardino-Balkar region in the Caucasus to the immense area of the Yakut region, whose boundaries are coincident with those of the Yakut A.S.S.R. In all instances, the boundaries of the new regions follow those of existing territorial-administrative units. In some instances, existing *oblasts* have been grouped together to form a new region (*e.g.*, the Leningrad *Sovnarkhoz* consists of the Leningrad, Pskov and Novgorod *oblasts).* Each Autonomous Soviet Socialist Republic has been preserved as an individual *Sovnarkhoz* region. The arrangement within the fifteen major Union Republics has varied. The R.S.F.S.R. contains seventy *Sovnarkhoz* regions. The Tuva Autonomous Oblast has apparently been left without the new system. The twenty-six *oblasti* in the Ukraine have been grouped into eleven *Sovnarkhozy*, while nine regions have been formed in Kazakhstan and four in Uzbekistan. Each of the remaining eleven republics forms one *Sovnarkhoz* region. The newest feature is the definition of Moscow Town as the only self-administering "town region" in the U.S.S.R. Populations in the new regions vary widely: the smallest are Magadan (240 thousand) and Kamchatka (209 thousand), but the Kiev *Sovnarkhoz* has a population of 8,544,000 and the Byelorussian *Sovnarkhoz* follows closely with 7,992,000. Moscow Town and Moscow *Oblast* have together a population of 10,505,000. Their economic geography likewise varies from the heavy industry and mining of Stalino and Voroshilovgrad *Sovnarkhozy* in the Ukraine to the forest and swamp economies of Tyumen and Kamchatka *Sovnarkhozy.*

The Soviet experiment in regional planning and economic geography thus continues to evolve. Much dispute remains over the boundaries of the Siberian *Sovnarkhozy*, notably the relationship between the old concept of a Lena-Baykal region and the present Yakut region. The creation of Tyumen *Sovnarkhoz* after calls for recognition by local opinion raises again a region conceived in the first Gosplan regional system, the Ob region. In contrast, reports suggest that in Central European Russia, certain *Sovnarkhozy* (Balashov and Kamensk) have been dissolved.[10]

Roy Mellor

[1] This note is based on a long discussion on Gegenwärtige Probleme der ökonomischen Gliederung der USSR in *Petermanns Mitteilungen*, Heft 4, 1955, which is drawn from Russian material and quotes a long bibliography.

[2] Notably G. N. Cherdantsev in his two-volume *Ekonomicheskaya Geografiya SSSR*, Moscow, 1956-1957. Other leading names include M.M. Davydov and N.N. Baranskiy, whose textbooks are standard use in Soviet schools.

[3] Shimkin, D., Economic Regionalisation in the Soviet Union, *Geogr. Rev.*, 1952, and Shabad, T., The Soviet Concept of Economic Regionalisation, *Geogr. Rev.*, 1953.

[4] Much of the criticism is based on comments made by two members of Gosplan.

[5] Much attention has been given to Yakutia in recently published Soviet material.

[6] Transport information is based on *Voprosy Rationalisatsii Perevozok Vazhneyshikh Gruzov*, by various authors, Moscow, 1957, and *Transport i Svyaz SSSR: Statisticheskiy Sbornik*, Moscow, 1957.

[7] Roitburd, L., *Razvitiye Chernoy Metallurgii SSSR*, Moscow, 1956.

[8] A useful summary is contained in *Soviet Studies*, Vol. IX, Glasgow, 1957.

[9] The new regions were discussed in association with a map of their boundaries in Die ökonomisch-administrativen Rayons der Sowjetunion by Täubert, H., *Petermanns Mitteilungen*, Heft 1, 1958.

[10] British geographers will understand the complaint of Russian geographers that they were not sufficiently consulted by the planning authorities during the development of the new *Sovnarkhoz* regions.

GLASGOW UNIVERSITY EXPEDITION TO NORTH RONA

During June and July 1958, a small party spent four weeks in North Rona (59°07'N., 5°49'W.), one of the smallest and most isolated of the Hebrides. The group consisted of five undergraduates who organised and administered the expedition from its inception, and included one reading geology, one veterinary science, two agriculture and one history. The five remaining members of the group included two marine biologists from The Marine Station at Millport, two nature photographers who had previously visited the island, and a geographer. It is intended that the present note should describe briefly some of the work undertaken during the four weeks and put on record some observations on the physical aspects of the island. The work was confined to the 300 acres of North Rona with the exception of twenty-four hours spent by six members of the party on neighbouring Sula Sgeir, thanks to the good offices of Dr Morrison of Bridge-of-Weir who enabled the visit to be made in his yacht. The expedition's thanks are also due to Cmdr Dumas and the crew of M.F.V. 289 from Aultbea for carrying out the successful landing and embarkation of the expedition on the south side of the island, at the first attempt on each occasion; this was no mean feat! Financial and other assistance was gratefully accepted from the University of Glasgow, The Carnegie Trust for the Universities of Scotland, Mr Charles Hepburn, and many individuals, institutions and firms. The staff of the Butt of Lewis lighthouse provided a welcome daily contact by radio with the outside world.

The isolated situation of the island has had a considerable influence on its plant and animal life and among the primary aims of the expedition were the study and collection of specimens of the marine flora and fauna and of the terrestrial flora. Interesting work was carried out on Leach's Fork-tailed Petrel and a large bird-ringing programme was completed, involving more than a thousand birds. A collection of the internal and external parasites was made from the island sheep for the Virus Research Laboratory at Ruchill. The other primary aim was to

complete a ground survey of the remains of habitation on the island, including the early Christian cell and church. The village remains consist of three groups of cells, originally corbelled and involving a number of periods of settlement, and what would seem to be a primitive blackhouse. An outstanding problem is to discover the relationship between this house and the other domestic structures. North Rona may be important in terms of the evolution of the 'Highland House'. A brief summary of the expedion's work has already been published[1], and it is hoped that eventually the material will be put on record in the appropriate places.

The island is comprised of Lewisian gneiss, granulitic in texture and showing strong differentation into acidic and basic fractions. Sheet-like intrusions of quartz-felspar pegmatite occur, the outcrops being largely controlled by folding along axes trending west-north-west. At its highest point the island attains 355 feet O.D. in Toa Rona at the east end of the island. The central ridge is at approximately 300 feet O.D. and is markedly assymetrical, the north side being vertical cliff at the east and west ends and a slope of average gradient 1 in 4 in the centre, while the south side is an almost continuous slope of average gradient 1 in 10. West of Toa Rona the ridge is broken by a depression trending from north-north-east to south-south-west between Geo Mairi and Poll Tothatom, while around the base of Toa Rona a number of geos, similarly oriented, have been cut into the cliffs. This orientation is joint-controlled, and jointing in the Lewisian is similarly responsible for much of the coastal alignment of the island. The main exception is on the south coast where slickensiding indicates a different origin. The peninsulas extending to the north and south-west are low wave-cut platforms in the Lewisian, and further notches or small benches are apparent at various points around the coasts and also on the rock of Gealldruig Mòr to the south-east of the island.

The surface deposits give clear evidence of glaciation. Covering most of the south side of the central ridge is a very thin deposit of boulder clay, which was examined by digging a number of small pits. Seldom more than one foot thick and often considerably less, the drift contains erratics of both Torridonian and Cambrian, some of which have been faceted. Many pebbles with single facets and a few cases of double-facated stones were found, but no instances of ice scratching, either on stones or on the solid rock could be found. Some very smooth surfaces of Lewisian do occur on the south side of the ridge which could have been ice-moulded. In the depression just west of Toa Rona a deeper deposit of boulder clay remains, exposed in sections at the heads of the geos at either end. The section at Geo Mairi consists of two to four feet of a reddish sandy matrix with a small clay fraction, and contains erratic and Lewisian boulders which tend to increase downwards. This is underlain by two inches of red sticky clay, although at one point the clay dips down and is separated from the boulder clay by lenses of reddish and grey sands to a maximum depth of two feet. These sands and clays appear to have been laid down in water. Loose scree obscures the bottom of the deposit but the solid rock is not far below.

The north side of the central ridge has no good exposures but one small pit was dug into the slope at about 250 feet O.D. Here at least one foot of greyish sand, clearly the product of decomposition of the Lewisian, and containing few erratics, replaces the the normal boulder clay. Lubrication of this sand on the very steep slope probably accounts for the well-developed terracettes in the sod at the surface, although the small sheep stock on the island may be have contributed to this phenomenon.

The rock platforms at various points around the island may divided into two groups. There are small benches, particularly on the west side and on Gealldruig Mòr which are just awash at high spring tides, and these are to be distinguished clearly from the bench or benches forming Loba Sgeir and Sceapuill to the south-west, and the northern peninsula of Fianuis. Time did not permit accurate levelling on these benches but approximate heights were obtained using a Watts surveying aneroid. Loba Sgeir is a small rock island where the surface has been planed off level across the cleavage of the Lewisian. The surface, tilted from west to east, has a gradient of about 1 in 60, and is highest at the west corner at 18-20 feet O.D. dropping to 6-8 feet O.D. at the east end. Loba Sgeir is separated from the peninsula of Sceapuill by a narrow, deep, joint-controlled gap, trending north-west to south-east. Sceapuill repeats the Loba Sgeir surface, with the suggestion of a higher one at 25 feet O.D.

Fianuis, the northerly peninsula, is a continuous stretch of wave-cut platform,

highest at the south-west where the cliffs are 80 feet high and dropping to 12 feet O.D. along the east side and 20 feet at the north end of the peninsula. Half way along there appears to be a break in the continuity of the surface and it is possible that the bench is composite, the lower northern end of which repeats the Loba Sgeir surface. Accurate leveling is needed to substantiate this suggestion.

More than half of Fianuis is covered by a deposit of head, occurring in two patches which are separated by a composite, joint - controlled depression from which the head has been removed, probably by the action of the sea at some time in the past, or possibly by modern north-easterly storms. The head is greyish in colour and contains flat, angular stones, mainly the native Lewisian but including a few erratics, the stones being aligned approximately north-south. The matrix is a mixture of coarse grit and light brown sand, clearly derived from the local rock. On the west side the finer material has been winnowed out by storms leaving the angular stones forming what earlier visitors have described as a storm beach [2]. The angularity of the material must preclude such an origin.

In one section on the east side the head overlies a beach deposit. This is exposed in a small cave cut into the head and trapped at the head of a minor geo cut into the east side of the wave-cut platform. The beach material is mainly erratic and consists of two feet of red brown sand overlying two feet of well-rounded beach boulders. The base of the beach is at 20 feet O.D. but the funnelling effect of the geo, responsible for the preservation of the beach, must be considered.

In view of the lack of a clear relationship between head and boulder clay, no attempt at a chronology is made. Clearly the head is later than the beach which in turn is later than the wave-cut platform. As both beach and head contain erratics it seems likely that both are subsequent to the local boulder clay. No evidence for secondary frost disturbance at the top of the head could be found but this means nothing for during the breeding season seals turn the surface into a veritable morass, so much so that the only plants that can survive are annual species. Detailed work on the boulder clay and an attempt to find a clear relationship between it and the head are both needed. At present North Rona must remain enigmatic in the picture of Scottish glaciation.

R. A. Gailey.

[1] *Nature*, Vol.182, pp.775-776. Sept. 20, 1958.
[2] Stewart, M., *Geol. Mag.* Vol.69, 1932, 179.

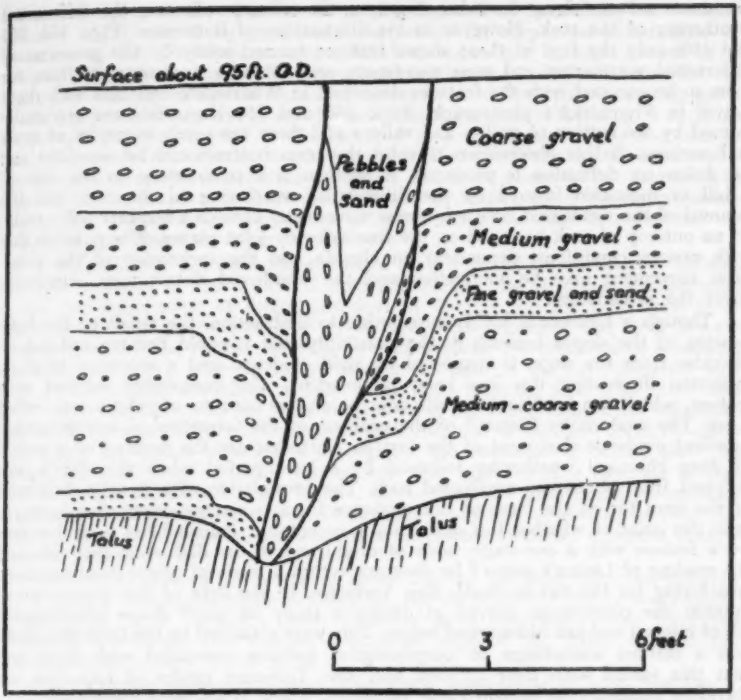
All heights were obtained using a Watts Surveying Aneroid, and while consistent within themselves and checked as far as possible, they are subject to a probable error of ±3 feet. The author wishes to thank those people with whom he discussed the features described.

NOTES ON PERIGLACIAL PHENOMENA

A FROST WEDGE IN ANGUS:

In the valley of the Lunan Water five miles north of Arbroath a pit has recently been opened in a thick series of fluvioglacial deposits (National Grid Reference 631490). These deposits exhibit very rapid variation from coarse gravel to fine sand, but in one predominantly gravel section an exceptionally fine example of a frost wedge has been revealed (See Figure). This extends to a depth of at least nine feet, and possibly a little more as its base is obscured by talus. From a maximum width of two feet it tapers downward towards a point. The bedding of the gravel in contact with the wedge is sharply contorted, individual beds being displaced downwards by more than a foot.

Unlike the Midlothian wedges described by Common and Galloway [1] the infilling is not of boulder clay but of three distinct grades of sand and gravel. Most of the fissure is filled with a coarse gravel similar to that bordering the upper part of the wedge. Many of the fragments are over three inches in diameter



and display a tendency to stand 'on end', that is, with their long axes vertical. Between this coarse gravel and the side of the wedge is a small pocket of finer material probably derived from the adjacent bed described in the illustration as medium gravel. Finally, in the highest portion of the fissure there is a mixture of rounded but poorly assorted pebbles set in a matrix of sand. Such material is not now found in the adjacent deposits, but is probably a relic of a former bed resting on the coarse gravel. If this wedge was formed in one stage (and it is difficult to believe otherwise) it is remarkable how clearly the original divisions within the surrounding gravel beds have been preserved in the infilling.

J. R. Rice.

[1] Common, R. and Galloway, R. Frost wedges in Midlothian. *S.G.M.*, 1958, 74(1):45-46.

TORS :

Dr Fitzpatrick [1] has recently redrawn attention to the problem of tors and it is therefore appropriate to raise the question of what is an acceptable definition of this term. In his article Fitzpatrick has used the term tor for two distinct morphological features. Firstly (p.28) for "promontories of rock — which jut out from the sides of hills and mountains" and secondly (p.35) for "rock pinnacles on summits" and "isolated remnant". An examination of Plate 1 in this article, illustrating "a line of well developed tors" used in this case for promontories of rock, confirms the view that they are in fact essentially the same features described and studied by this writer [2] and called rock bastions. Linton [3] has suggested that the alternative term buttress is more suitable in the light of the previous use of rock bastion for a glacial feature. Buttress has been used by Von Engeln [4] for

prominent salients along the sides of gorges, the salients reflecting the differential weathering of the rock. However in his illustrations of buttresses (Figs. 164, 165 and 166) only the first of these shows features formed solely by the processes of differential weathering and mass movement, and this is a necessary condition for them to be equated with the features described in Wharfedale and also with those shown in Fitzpatrick's photograph. Figs. 165 and 166 show features essentially formed by the cutting of gullies and valleys and these are surely examples of spurs and outliers. If this observation is valid the term buttress can be accepted and the following definition is proposed. A buttress is a promontory on the side of a hill or mountain formed by the differential weathering of the rock and the removal of the weathered debris by mass movement. Though a buttress will usually be an outcrop of rock bounded on the free sides by joint planes, it is possible that with certain conditions, dependent on climate and the inclination of the slope, mass movement may be ineffective and the weathered debris may completely cover the promontory.

Though a buttress is highly susceptible to destruction, the result of the back wasting of the slopes beneath it, the possibility that it could become isolated on all sides from the slope is suggested by field evidence and a sequence of slope evolution illustrating this has been proposed [2,5]. The completely isolated rock feature, which can be found on hill sides or on the summits of ridges, was called a tor. The analysis by Linton [3] of the problem of the formation of tors presented excellent evidence that most of the tors on Dartmoor are the product of a period of deep chemical weathering followed by a later period when this debris was stripped from about the unaffected rock. The formulation of a genetic definition of the term tor on the basis of this evidence for a two-stage origin does however raise the point of whether this definition is acceptable. Palmer [5] has used the term for a feature with a one-stage mode of origin and in the discussion that followed the reading of Linton's paper [3] he does not accept a mode of origin involving deep weathering for the tors in North East Yorkshire. In the light of this divergence of opinion the conclusions arrived at during a study of tors [6] above Wharfedale [2] are of interest and are summarised below. Tors were classified on the basis that there was a distinct assemblage of morphological features associated with them and that this varied with their location and size. Different modes of formation are therefore necessary to explain these variations. Three types were recognised:

1. Large, massive tors with sides 30-50 feet high rising from the flat summits of the higher fells (up to 1,500 feet) or from the apex of low hills rising with gentle, concave slopes from an extensive erosion surface (700-800 feet). Following the early suggestions of Linton [7], these typically 'Dartmoor type' tors were attributed to interglacial or preglacial deep chemical weathering followed by a period of stripping by periglacial solifluction which left the unaffected core stones standing as tors. Though no exposures of deep weathering are known, the high felspar content of the coarse and massive grits and their location are favourable to this theory. The close association of these tors with erosion surfaces, and therefore comparable with those described by Penck [8], is the most important factor which distinguishes them from the second and third types of tor.

2. Small tors with sides up to 10 feet high rising from the surface of one of a flight of flat benches (width 300-400 feet, height interval about 10 feet), whose surfaces are covered with large, tabular blocks of grit. The benches are formed by the disintegration of individual grit beds and the removal of a greater part of the debris leaving only the largest blocks. The underlying bed is unaffected, or protected by the overlying blocks and the small tor rising from the bench represents a residual block, the thickness of the grit bed, which has survived by reason of wider joint spacing and lack of horizontal joints. The flat benches are cut into a hillside with a measured inclination of four degrees in one instance. A theory of formation involving deep weathering is not favoured by the evidence. The angular nature of the blocks and the need to explain the nature of the removal of the finer debris has led to the conclusion that periglacial frost shattering and removal of debris by snow melt or solifluction is the most satisfactory explanation of these features resembling small altiplanation terraces.

3. Tors of variable size rising from hillsides with a slope of ten degrees or more. From the foot of the tor a blockstream usually passes down the slope and these have been observed to extend across wide, structural benches at the foot of the hillside. This type of tor has been observed in horizontal strata, and also where

the strata dips into the slope at thirty degrees, and is formed by the complete isolation of a buttress by progressive retreat of the slopes on either side. The extension of the blockstreams across the benches whose inclinations are of the order of 2-5 degrees suggests that periglacial solifluction is responsible for the back wasting of the slopes, the tors remaining by reason of differential weathering guided by joint planes. Where the strata dip into the slope massive bedding is no longer a condition for the survival of the tors and they are formed of several thin grit beds. Where the buttress or tor is formed in horizontal strata and is located at the edge of a scarp, detachment of blocks has been observed by the formation of gulls and the cambering of the bed followed by rafting down the steeper section of the slope. This does not appear to be active today and may be associated with periglacial conditions as is has by Kellaway [9].

Confirmation of the existence of two of these types of tor outside the Millstone Grit area is found in the work of Linton and Palmer, the first type corresponding to the two-stage mode of origin proposed by Linton and the third type to the one-stage mode of origin proposed by Palmer. With regard to the latter however it must be noted that Palmer can find no evidence that the processes of weathering and mass movement were intensified during the time of the last Glaciation when most of North East Yorkshire is believed to have been ice free. This observation is not believed to be valid for West Yorkshire but the comparison is not invalidated thereby. All slopes in the unglaciated areas at the time of the New Drift Glaciation must have undergone denudation throughout the sequence of inter-, peri-, and postglacial time. Whether slope retreat was most active during any one of these periods would depend on many factors, three important ones being susceptibility of different rocks to different types of weathering, presence or absence of vegetation and the type of vegetation, and variation in climate between different areas at any one period.

The second type of tor described above has not yet been recorded elsewhere and though a periglacial origin is favoured, the evidence for this is not regarded as conclusive. It is probably better classified as a variation of the third type formed in one-stage with distinct conditions imposed by thinly bedded grits outcropping on a very gentle slope.

The evidence presented above favours the acceptance of both theories for the formation of tors. Linton however in proposing a genetical definition for the term tor, which demands deep chemical weathering followed at a later date by the mechanical stripping of the debris, excludes the use of this term for similar features believed to have been formed in a slightly different way. These he would call stacks. Before accepting this distinction it is as well to examine more closely the nature of these differences and the factors involved. All these features are the product of the differential weathering of rock and the removal of the weathered debris by mass movement to leave the unweathered rock outstanding from the surrounding slopes. In any rock where, by reason either of differential spacing of the joint pattern or by changes in chemical composition, differential weathering can occur, tor-like features may be formed. Thus it is reasonable to expect that they will be described from many lithologically different areas. Differential weathering may be mechanical or chemical or be composite, and this can best be determined in the laboratory with a microscope. The intensity and to a lesser extent the type of weathering are dependent on climate. Chemical weathering is most active in a humid tropical environment [10] but is also active in a temperate and possibly even in a glacial environment [11]. Mechanical weathering, though present in hot arid areas, is probably most effective in the middle and higher latitudes where freeze-thaw cycles affect ground water. Both chemical and mechanical weathering attack the rock along joint planes. Over much of the earth both types are active in a single year and so weathering is best regarded as composite in the middle latitudes. Indeed the increase in the porosity of a rock as it is attacked chemically will increase the effectiveness of mechanical weathering. Chemical weathering is not therefore believed to be a requisite condition for the formation of tor-like features, all that is necessary is differential weathering of an unspecified type. As an example tors in granite may be taken. They have been recorded from the tropics and here the weathering must necessarily be chemical but they have also been described from Alaska and the weathering here is mechanical. It is therefore suggested that Linton need not look back into the Tertiary for the period of the weathering of the Dartmoor tors but it is suggested that it is best

regarded as composite and only by petrological analysis of numerous samples can the relative importance of each be determined. This idea of the composite nature of the weathering in the Dartmoor area is believed to be valid for the whole of the British Isles and only in the case of those rocks which are chemically resistant, such as quartzite, would the specification of the type of weathering seem valid.

The stripping of the weathered debris is by mass movement, climate and inclination of slope being the most important variables affecting the type and rate of movement. To a lesser extent the composition of the debris is also important, the rate of movement being affected by the size and shape of the fragments and by the presence of a clay residue if chemical weathering has been active. The debris will remain in situ only if the type of mass movement active at the time of weathering is ineffective and this will depend or the inclination of the slope. Thus the evolution of tors in two distinct stages as envisaged by Linton is a reflection of the very gentle slopes associated with an oldland and the weathering of the rock at a time when solifluction, the type of mass movement active on slopes less than ten degrees, was not active. Though solifluction is associated mainly with periglacial conditions of permafrost, the movement of material over gentle slopes can occur when the surface layer of the ground is saturated with water and such conditions are possible in the humid tropics. Though a thick cover of vegetation will prevent this in most cases, the possibility of debris flow beneath the root layer has been suggested [12] as operative. If the weathering of the Dartmoor granite was by tropical conditions then the removal of the debris immediately after formation can be envisaged. If the weathering took place during an interglacial period of temperature climate then the debris would remain in situ until removal by periglacial solifluction. Though weathering would continue during this time the origin of the tors would essentially be two-stage. Though the writer does not know Dartmoor well, it is apparent that all the tors are not located on the flat summit areas. Some do in fact overlook the steep slopes above the deeply incised sections of the rivers and others are located on valley sides. A two-stage origin for these tors is believed to be impossible. A similar dual location of tors has been recorded above Wharfedale within one-quarter of a mile of each other, and though they are believed to be two- and one-stage in origin they are not believed to be different features. The inclusion of the two-stage origin as a necessary qualification for a feature to be called a tor is therefore believed to be unjustified.

It is suggested that the following definition of the term tor is more appropriate. A tor is an exposure of rock in situ, upstanding on all sides from the surrounding slopes and it is formed by the differential weathering of a rock bed and the removal of the debris by mass movement.

It is believed that tors probably have a world wide distribution. They will vary in size and shape for the lithology and structure of the rocks varies and so does their location. They will vary in age for once formed they will be resistant to destruction by weathering but will be destroyed by the back wasting of the slopes beneath them. For this reason valley-side tors, will be short-lived features while summit tors may be of great age. It is impossible to assign a transformation in periglacial, interglacial or preglacial times unless a detailed study of the nature of the weathering is undertaken and this must include examination of the debris under the microscope when the degree of chemical weathering may be ascertained.

By suggesting the use of the term tor in this broader sense, the use of the term by Palmer, Peltier and many other writers is no longer inconsistent with the proposed definition. If geomorphologists wish to distinguish between variations in the type of weathering and mass movement they favour as operative in the formation of a particular tor, or between a one-and two-stage evolution, it is suggested that this is best done by the use of qualifying adjectives and sentences.

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R. A. Pullan.

CONTEMPORARY PERIGLACIAL PHEMOMENA IN WESTERN SCOTLAND

I have read with much interest Dr Fitzpatrick's article in a recent issue of this magazine [1]. I wonder however if contemporary periglacial phonemena (stone polygons and stone stripes, in particular) are as rare as he would suggest. For instance here are some particular examples from relatively low altitudes:

At the summit of *Ben Buie* (2,354), in the zone between 2,354 and 2,341 feet and over an area some 500 m. wide, a large field of shattered angular rocks with sharp edges is found; certain rocks show recent splitting by frost. They feed adjacent screes and are revealed, not far from the summit, in terracettes and block flows. As the gradient of the slope decreases, a series of circles and polygons can be seen to appear. In the centre of each of these, small pebbles and gravel. .5-1. cm. long, cover a brownish soil. The diameter of the area of the fine material can attain 40 cm.; around it is a crown of angular rocks 10-15 cm. broad. A form of transition between the block flows and the circles exists on intermediate slopes: these are stone stripes where the bands of fine material are twice as wide as those of coarse material. All these forms, less clear than on the summit of Storr(Skye) but more numerous, correspond to a zone of Alpine flora. They are, moreover, well-marked in the zones without vegetation but yet sufficiently humid — between rocky crests for example.

On *Ben More* (3,169 feet), Mull, near the summit contemporary periglacial phenomena can also be observed. Angular rocks, whose fresh fractures are due to contemporary frost action, form fields as extensive as those on Ben Buie; terracettes and block flows are also found. The poor development of horizontal surfaces must explain the only mediocre developments of stone circles except for a few rare examples. In contrast, the great number of intermediate slopes must be directly related to the frequency of typical striped soils which descend, in fact, to an altitude of 1,800 feet. The width of the coarse bands rarely exceeds 10-12 cms: that of the fine bands can attain 30-40 cms.

Sgurr Dearg of Mull (2,249) offers analogous forms on its gently inclined south-west slope. From a sea of blocks, rocky outcrops emerge from time-to-time. Rock flows and terracettes are here very widespread. But striped soils are not rare and are well-marked from the point of view of granulometry. The bands of fine material are from 20-40 cms. wide, those of coarse material from 10-18 cms. In addition there are some stone circles of reduced size (diam. of fine elements: 15 cms). The interest of Sgurr Dearg is to show side by side actual forms and ancient static forms more or less covered by vegetation and angular rocks but with blunted edges, old polygons which seem, in general, to have greater dimensions that the contemporary phenomena. The latter can be seen down to about 1,800 feet.

At a much higher altitude (2,423) *Beinn Mheadon*, Morven, does not however exhibit contemporary periglacial forms. The reason appears to rest in the different lithology of the material. The resistant granite of this height is less favourable than the basalt or dolerite of the preceeding summits.

Alain Goddard.

REVIEWS OF BOOKS

EUROPE

A Survey of Whitby and the Surrounding Area. Organized and edited by G. H. J. Daysh. 11×8½. Pp. XV + 254. 35 figs. 42 Plates, (separate portfolio of 5 large folding maps). Eton, Windsor: The Shakespeare Head Press, 1958, £3.3.0.

An urgent problem which faces many of the older towns of Britain is their adjustment to changing economic conditions. In so many cases the original reasons for their foundation and growth no longer apply: having lost their original *raison d'être* they must find a new one. Of fundamental importance is a clear understanding of the present position and of the factors which have led up to it. The old port and abbey town of Whitby is fortunate in having a right-minded council appreciating the situation, and a good friend in the Marquis of Normanby who commissioned a very able team of investigators under the direction of Professor G. H. J. Daysh to prepare this magnificent survey and to publish it in worthy style. The contributors are J. E. Hemingway of Leeds University (Geology), J. H. Appleton of Hull University (Communications), E. Allen of Durham University (Economic), M. R. G. Conzen (Historical), J. W. House (Population) and D. H. Fryer (Whitby Harbour), all of King's College, Newcastle-upon-Tyne.

From the foundation of the Abbey by St Hilda in 657, Whitby enjoyed some centuries of ecclesiastical preeminence; then a long period as a fishing and coastal port. The development of the alum industry arrested what might have been a decline, then the great Whitby jet industry. Our Victorian grandmothers were scarcely to be regarded as properly dressed at least on Sundays without a jet brooch, and even grandfather had his jet watch-chain for funerals. Enough of the old and quaint and enough of modern attractions and conveniences exist to encourage a large but very seasonal tourist trade, but one more and more limited to a Sunday trip by car. Now Whitby has become largely a pleasant dormitory town, not too well served by communications, for Teesside. The discovery of potash salts in depth seemed to hold out hopes for a bright future, they are unworkable economically at present. L.D.S.

Wales. A Physical, Historical and Regional Geography. Edited by E. G. Bowen. 3¾ x 5¾. Pp. 528. 143 Figs. London: Methuen & Co Ltd. 1957. 42s.

We are very grateful to Professor Bowen for the latest addition to the well-known Methuen series of regional geographies, for it represents scholarly work and a wealth of detailed information. The team of six contributors has co-operated under Professor Bowen's guidance in the production of all three sections, of which the longest is that devoted to the sub-regions. Some overlap is to be noted between the historical section and some of the detailed regional studies, perhaps in an effort to preserve a comprehensive treatment of each. A general impression is that the book has been written very much with an eye to the intrinsic characteristics of the country; the wealth of place names mentioned is a little overfacing for the reader without a detailed atlas. There are numerous maps and diagrams, but even a few photographs would have helped to give a far more vivid impression to those who are not familiar with this country, one of the most interesting scenically within Britain. The individual regional studies suffer somewhat from an excessive deference to the idea of a transition zone; they are apt to seem amorphous in the hands of a team which does not re-unite the divisions into the essential whole. Professor Bowen's earlier work on *Wales; a study in Geography and History,* is neither technical nor detailed but has a broad appeal, in its singleness of purpose in characterising Wales, which is scarcely achieved in the larger work. Nevertheless the Department at Aberystwyth has provided a most valuable regional description on a scale nowhere else attempted for one of the major divisions of Britain. H. F.

The Glasgow Region: A General Survey. Edited by Ronald Miller and Joy Tivy. Pp. XIX + 325. 20 plates. 68 Figs. 37 tables. Prepared for the meeting of the British Association, Glasgow, 1958.

This is a handsome addition to the series of regional surveys designed partly as a guide to and partly as a momento of a modern meeting of the British Association. The task of preparing such surveys has added immensely to the burden placed upon our hosts on these occasions but the labour is clearly well worthwile.

The work contains twenty-three essays ranging in scope from an account of the physical landscape of the region to the development of some of its academic institutions, but there is a clear major theme in the rise and growth, through many vicissitudes, of the Clydeside conurbation in an area where the physical framework has left remarkably little room for manoeuvre. Problems of competing land use, familiar enough throughout industrial Britain, are thus encountered here with startling intensity.

A complex geological history which Professor George sketches with admirable lucidity has set the scene and provided, here and there, great wealth in mineral resource. Atlantic winds and a fitful sun drive farming down into the hollows which geology has prepared. Here too must grow the towns and the industrial establishments which two centuries of rapid economic development have called forth. Yet the story told by Professor Pryde in "The City and Burgh of Glasgow", by Messrs. Gilfillan and Moisley in "Industrial and Commercial Developments", and by Professor Cairncross in "The Economy of Glasgow" is very far from one of geographical determinism. It is the story of opportunities seized and disappointments suffered. The consequences of economic change may well be inexorable but could this history, rich in incident, ever have been foreseen?

Professor Miller, in an essay which is as succinct as it is spirited ("The Geography of the Glasgow Region"), points out that "Glasgow men brought alternatives from the ends of the earth" but his co-editor Miss Tivy in "Population Distribution and Change" is faced with the very consequences of their enterprise and success — "nearly two million people" living "within an area some ten by fifteen miles in extent". Even so, the very acute urban overcrowding, reaching locally — "almost the same as in a graveyard", owed something to cultural factors. Yet its relief by dispersal or overspill raises geographical problems of great intractability. Is this then the nature of "environmental control", that it never directs and rarely forbids, but always exacts its price, however long the reckoning? P.R.C.

Shetland life under Earl Patrick. By Gordon Donaldson. $8^3/_4 x 5^3/_4$. Pp.VII + 149. 16 plates. Edinburgh and London. Oliver and Boyd, 1958. 15s.

The book is based on material culled from a number of legal sources dating from the first three decades of the seventeenth century. By quoting freely from these sources, the author has attempted to give an insight into the customs and level of material well-being of the Shetlanders of that period. The Court Book of Shetland for 1602-1604, which is the author's main source, consists of a sequence of disjointed entries and something of this disjointedness has persisted in the pages of the book.

The division of the book into chapters on "The Land", "The Sea", "The People" and "The Law" has led to a certain amount of repetition, but there is no doubt that the author has made available a considerable amount of interesting and, in some cases, curious information about seventeenth-century Shetland, though geographers might have hoped for a greater degree of synthesis and a more determined attempt to work along quantitative lines.

One major criticism concerns the illustrations, which are not integrated in any way with the text and which are rather misleading. They do not of course directly illustrate the period under discussion in the text, and, inserted as they are without sufficient explanation, they would tend to lead the reader to assume that they represent typical conditions of the present day, which many of them *e.g.* those showing sail-powered flit-boats, and the flitting of peat by pony, certainly do not do. A. S. F.

AFRICA

Geographical Essays on British Tropical Lands. Edited by R. W. Steel and C. A. Fisher. $5^1/_2 \times 8^1/_2$. Pp.X + 344. Maps and diagrams. George Philip & Son Ltd., London, 1956.

Prima facie one might doubt whether there was sufficient justification for binding into a single volume eight essays whose kinship lay only in their being geographical in approach and devoted to areas within the British tropical lands. When, in addition, it is suggested that the essays demonstrate the value of applied geography, one's doubts deepen. In the event, however, such doubts are turned to congratulations and one's criticism of the book is virtually restricted to its rather dry title, which will deny it the attention of many lay readers who might otherwise have read it with enjoyment and profit and, by corollary, has lost to geography the appreciation of such lay readers.

Disparate as are the topics under review, they have in common that they tackle problems vital and peculiar to the tropics, such as, on the physical side, the close examination by Farmer of rainfall reliability and effectiveness in Ceylon or of soil erosion, particularly in Nigeria, by Grove. Historical and economic factors, with 'colonialism' dominant, unite the studies by Steel, Ford and Paget and perhaps the most complete synthesis of all is Fisher's exposition of the problem of Malaya. In every case, the subject has strong practical overtones and the essays should contribute to the understanding by men of affairs of the problems dealt with, whether they be directly and even simply physical, like the conservation of land. or on a highly controversial and imponderable plane like that of the wise disposal of Malaya's future.

Such a volume of essays at this time is possible only because of neglect in the past of research, geographical or otherwise, into problems peculiar to the tropics and especially the British tropics. So little systematic work has been done in the past that we are grateful for essays such as this, even though in places they are forced into generalisations, which, for want of more detailed knowledge, we must accept though we may mistrust. Some of the details of the essays, too, are open to criticism. While admiring the intimate knowledge of French conditions and point of view brought out when dealing with transport in British West Africa, we may grumble at the relative neglect of river transport on the Niger and Benue. Nobody would guess from this essay, either, that Kano was an international airport of the first order: more detail is given on the airfield at Benue, and indeed to Monrovia, which is not British.

Is is a small point that Hausa names for the Fulani are mis-spelt, but, more serious, the spelling of some Hausa place-names does not accord with that in their homeland. Messau for Misau, Gandi for Gwandu and Demagrun for Damagaram for example, could lead to confusion. Most of the maps are excellent but in some the small lettering is indeed very small. R. M.

West Africa: A Study of the Environment and of Man's Use of it. By R. J. Harrison Church. $3^3/_4 \times 5^3/_4$. Pp. XXVII+547. 89 Figures. 121 Plates. London: Longmans, Green and Company 1957. 45s.

Dr Church must be congratulated on the Herculean task he has performed in amassing so much material on West Africa. There are over 500 pages, 100 line blocks and 120 half-tones. He has sought out every available piece of information on West Africa, toured some 20,000 miles in the region and nearly all his chapters have been submitted for critisism to experts in their field. And yet your reviewer has the ill-grace to be dissatisfied, for he holds firmly with Sorre that "Toute géographie est description et tableau, donc composition, donc choix. Il faut choisir, élaguer courageusement dans les dossiers". The author would appear to have felt something of the sort himself for in the Preface he says of the book "it does not necessarily include all that might be regarded by some as geographical; nor is its scope confined to matters exclusively geographical styled". This is a curious protest in a book "A Geography for Advanced Study" but it is nonetheless accurate, for the work is essentially a compendium, an exercise with scissors and paste, rather than a geographical analysis. There is, it is true, a curiously formal framework of 'geographical' headings but these usually serve merely to cause repetition

and to increase the bulk of the book. We are told for example, on pages 9, 16, 186, 193 and Fig. 40 and Plate 42 that the Mamelles on Cape Verde are Quaternary. An interest in such forms may be understandable, but it could be expressed more concisely. There are many other examples of repetition, but what is more serious is the frequency with which one feels that space is allocated to a topic in proportion to the amount of information available on it, rather than to its inherent importance. For example much of the story of African illheatlh and poverty, even polygamy, could be related to the tragic facts that cattle in West Africa are few, ill-distributed and yield milk in cup-fulls where European cattle give gallons. This is dismissed in less than a line: — "Zebu cattle are relatively poor milk-yielders . . ." and this though we are given much detail as to species of cattle and their varieties. Whereas on one hand the syntax of the book suffers in places from an attempt to compress it, space is wasted elsewhere by glimpses of the obvious — "Cold nights require people to have more blankets" — "more of these barrages might transform this poor land" — "If the price of gum became more favourable, more could be exported from this region" and the charming apology for the climate of West Africa — "If the right food is bought, prepared and served thoroughly clean and fresh, water boiled and filtered, insects kept out of houses, the usual prophylactics and daily exercise taken, sensible light clothes worn and strong alcohol avoided or drunk in moderation, then anyone with normal blood-pressure should keep very fit". Anyone with normal blood-pressure after all that could survive any climate.

Further detailed adverse criticism might be made, particularly of the treatment of geomorphology — "Rivers flow rapidly over the bedrock with hardly any kind of true valley and have many rapids" — but this would be to unbalance the review. With all its faults — and there are many — the book serves a useful purpose and is a major contribution to the literature of West Africa. If not a text-book, it is at least a very full and useful year-book and it gathers within its ample bulk an enormous amount of raw material for geography. It is excellently produced, with clear maps and many references to literature. Immense care has been taken with proof-reading but there are inevitably some slips, not serious perhaps except for the scale on Fig. 67. R.M.

ECONOMIC

American Commodity Flow: A Geographical Interpretation of Rail and Water Traffic based on Principles of Spatial Interchange. By Edward L. Ullmann. $5^3/_4 \times 8^3/_4$. Pp.XXII + 215. 6 tables. 164 maps. University of Washington Press, Seattle, 1957. $4.00.

Though this book has less than fifty pages of text and much of that will already be familiar from Professor Ullmann's articles in various periodicals in recent years, it is an essential for economic geographers. The author has specialized on the mapping of commodity flows in the United States, where it is the good fortune of transportation geographers to have the Carload Waybill Statistics of the Interstate Commerce Commission at their disposal. While the text is brief it is accompanied by 164 maps. The majority of these refer to origins and destinations of the rail freight traffic of twenty representative States and waterborne traffic in United States coastal sectors. Other maps show commodity flow on United States and Canadian railways and United States inland waterways and a concluding section shows ocean trade.

The cartogram analysis has been used to interpret the pattern of American commodity flow and develop a theory therefrom. It is to be hoped that transportation studies of this kind will extend to other countries and enable flow analysis to be applied to the understanding of the physioolgy of economies outside the United States. The volume is lithographed. C. J. R.

A World Geography of Forest Resources. Edited by Stephan Haden Guest, John K. Wright and Eileen M. Taylor. Pp. XVIII + 736. 110 plates. Maps and diagrams. Special publication No. 33 of the American Geographical Society. New York: The Ronald Press, Co. 1956. $12.50.

The producers, editors and 35 contributors of chapters of this work are to be congratulated on a valuable and readable book, covering the entire world and

much debatable ground, on the whole fairly and reliably. The photographs are excellent. There are useful references to literature at the end of some chapters, a bibliographical note on other sources of further information, a botanical index and a general index. The Director of the American Geographical Society explains the aim and main features of the work in a brief preface. Six excellent chapters deal with the world-wide aspects of forests and 25 chapters deal with particular regions. Some of the regional chapters are much better than others but in general the standard is good.

The first five general chapters describe the immense importance of forests to mankind, past and present forests and their influences, the principles and practices of forestry, and the major forest-products and industries. There is an inevitable conflict over forests between those wishing to clear them for crops and flocks, and those wishing to conserve them to supply wood in perpetuity, to protect the land from erosion and floods, and for climate and other good reasons. Half the total annual world cut of wood is for fuel, still, and there is an immense difference between the per capita use of wood in various countries. The U.S.A. itself uses half the present total world production of wood-pulp. She has a waste of perhaps 100 million tons per year as by-products of her forest industries; but economic factors at present limit the possible use of this waste, though great efforts and advances are being made towards fuller use.

The sixth general chapter (No. 31), is one of the most interesting. It discusses the outlook for the world's forests and their products. The author rightly stresses that price is a critical factor, and that good forestry practices are impossible unless economically feasible. He casts doubt on some of the estimates of great areas of forest available in Africa, South America and Asia, and their timber value. Mere area is misleading. The annual growth-rate of wood per acre is much more significant. In cold countries the annual growth is very low; and in the tropics the soils are apt to be poor and easily impoverished by leaching. He suggests wisely that the crux is to make the best use of the forests and land at present within reach, rather than to depend on the inaccessible areas.

Space permits only brief remarks on some of the regional chapters. In Canada fire burns 2,400 square miles of forest per year and 75 per cent. of the fire is caused by man. In the U.S.A. forest growth and forest drain, or cut per year, are about equal in volume but the quality is falling because the better trees are being over-cut. 75 per cent. of the forests are privately owned. On about two-thirds of the private forests the cutting or management is still "poor or destructive", though great efforts are being made to educate owners, with success. Much detailed information is given on South America. Over half the forests of that continent lie in Brazil, and the Amazon basin forms about one-third of Brazil. Correct work by an international team of foresters under the Food and Agriculture Organisation of the United Nations is throwing much light on the Amazon forests and correcting misinformation and ignorance.

The chapter on the Scandinavian countries is authoritative and excellent. That on the British Isles is disappointing, with no mention of such crucial points as the present target of the United Kingdom, which is three million acres of new planting and the putting in order of two million acres of existing woods, to supply in time one-third of the country's needs of wood and wood products, such as pulp and paper. Those interested should refer to the excellent annual reports of the Forestry Commission and the lucid Zuckerman & Watson Reports of 1956-57.

Africa is well-pictured in outline, with emphasis on its great extent of poor, dry forest or scrub, and the immense effects of man's long continued use of fire and shifting cultivation, even on the dense rain forests of the heavily wooded zone of West and Central Africa. In the U.S.S.R. there is a great move of the timber industry eastwards to the Urals and Siberia, owing to the exhuastion of the accessible western forests, and great difficulties with transport and labour. Outstanding work on shelter-belt planting is being done in Russia, where the climate puts a premium on such work.

In Asia the forestry effort in India, Pakista and Burma is unique in such tropical or warm temperate countries, both in scale and success in the teeth of difficulties due to population pressure, poverty and racial differences. The British have reason to be decently proud of their long record in this field. Some of the references to this record, in the chapter on India, might have been more generous. In Indonesia the Dutch in their time did excellent forest work and laid foundations

of great value to the inhabitants of that country, as did the U.S.A. in the exceptionally rich forests of the Philipines, and the British again in Malaya and Borneo. China presents a sorry contrast, with woefully devastated and inadequate forests from which to meet even a fraction of the real needs of her immense population However, her industry and skill are such that late as she started she may yet work wonders.

Finally, in the southern hemisphere the chapters on Australia and New Zealand are again authoritative and excellent. The story in New Zealand is particularly interesting. Starting with some of the world's finest native conifers, such as kauri, New Zealand used them lavishly; but in good time as far back as 1896, she began to experiment with exotics; and in 1925-35 planted great areas with a relatively scarce Californian tree, *Pinus radiata* or *insigne*, the Monterey pine. It is of no economic importance in the U.S.A. but in the southern hemisphere it has been planted on a large scale, with outstanding success. So far the results have been surprisingly good, despite a regrettable lack of proper thinning and pruning after planting. In New Zealand the annual output of exotic pine lumber, mainly *radiata*, has arisen to 230 million board feet in 1954, most of which was used in the country for house building and many other purposes, with an export to Australia also. Further, a great pulp and paper industry is being developed, on the exotic pine, with even better results than the lumber has achieved.

It is clear that the swiftly rising population of the world will have great need of trees and all other forest resources, slow or fast growing. The book under review has performed a notable service in bringing together in readable form much information on the world's forests and their products, which are vital to the future of mankind, even in the atomic age. C. W. S.

GENERAL

Bibliography of Land Economy and Ownership, 1900—1957, "A full list of the works relating to the British Isles and selected works from the United States and Western Europe", by D. R. Denman, J. F. Q. Switzer, and O. H. M. Sawyer. 10×7½. Pp.412. Published by the Department of Estate Management, Cambridge University, 1958. 35*s*.

The study of the land is of great importance to geographers and this tool to research should be welcomed by all interested in rural studies. The authors have combined in this work a vast fund of reference material derived from all relevant books, articles, memoranda and periodicals published in Britain between 1900-1956. Works, in most of the West European languages published since 1945, have also been referred to. The result of this diligent sifting is a comprehensive bibliography relating to the land, in the British Isles, Western Europe,and the United States.

The multitude of references contained within this 400 page volume have been listed carefully by subject, author and index. A classification scheme enables the researcher to find his source material. Headings within this scheme give some idea of the value of the work. "History", "General" headings form a practical introduction while under "Rural Economy", "Land Economy", "Estate Economy", "Research and Education", the majority of entries occur. The classification concludes with a section relating to reference works, with sub-headings entitled "Bibliographies", "Periodicals", "Statistics" etc. A final section deals with "Foreign Works" where titles in Danish, French, German, Dutch and Italian are included. An alphabetical list of authors in English occupies 132 pages and foreign languages 10 pages. The work concludes with an adequate index which occupies 7 pages and includes about 400 items.

The authors suggest that rural studies are neglected among research workers but they have gone a long way to remedy this deficiency by providing a very adequate source for students, whose numbers, as a result, should be increased. I.A.G.K.

General Geography. By J. Wreford Watson. 6½×8½. Pp. Numerous maps. diagrams and photographs. Toronto: Copp Clark, 1957, 30*s*.

This book is an outline of the elements of geography for Canadian high school and college students. Professor Watson draws upon his wide knowledge of Canada and, wherever appropriate, uses Canadian examples to illustrate the text.

Physical and human geography receive approximately equal emphasis. The former is covered by 13 chapters dealing with mathematical geography, psysiography, climatology, biography and the geography of soils, and the latter by treatment of various aspects of economic and social geography in the remaining 16 chapters. Maps and photographs are liberally used but in reduction and printing some have lost their clarity.

The direct value of *General Geography* will be to Canadian students and teachers. Indirectly it will merit a place on British bookshelves as one contemporary expression of the field of geography and, to some extent, as a source of information on Canada. Professor Watson's treatment of regions and urban geography are refreshingly realistic for a book at this level J.D.C.

World Geography. Edited by O. W. Freeman and J. W. Morris. 10½×7½. Pp. VIII + 623. 17 pages of full colour maps, numerous figs, maps and diagrams. New York: McGraw-Hill, 1958, 62*s*.

The 16 authors of *World Geography* have produced a book that is intended ".... to give college and university students information about nations and continents to help them in their understanding of world affairs...." Some of the authors have been more successful than others in presenting information at this level, and the chapters on Africa and South America have become very much catalogue descriptions of political units.

Although well illustrated, map titles and captions are sometimes confusing and the legends occasionally incomplete. Eight pages of Jeppesen continental maps in colour constitute an attractive (but surely unnecessarily expensive) introduction to the book. One of a number of similar volumes prepared by American geographers recently, *World Geography* is more suited to North American than British requirements. J.D.C.

MAPS

The Map of Great Britain, circa 1360, known as The Gough Map. 2 sheets (col. + 3 overlays). 23½×24½. An introduction to the fascimile by E. J. S. Parsons with The Roads of the Gough Map by Sir Frank Stenton. 12¼×9¾. Pp.38. Printed for the Bodleian Library and the Royal Geographical Society by the University, Oxford, 1958.

This is a splendid reproduction in colour of the famous map in the Bodleian Library, acquired in the Gough collection in 1809. The compiler and draughtsman are unknown. The map measures approximately four feet by two feet and represents Great Britain on a scale of about 16 miles to an inch.

The original on vellum is badly worn and in many places almost indecipherable, so E. J. S. Parsons has made an admirable and exhaustive study, using ultra-violet light. He has been able to identify practically every name and legend and has provided with the facsimile two transparent overlays. One is a transcript of the place names and the other gives their position on a modern map.

The excellent memoir by Parsons and Stenton shows that the map was compiled for travellers to show roads and towns; rivers are also clearly shown. It was based on road surveys and the map is surprisingly accurate for most of England, but not for Scotland, Wales or South West England, where no adequate road frameworks existed at that time. It is probable that it was copied from an official road map, used until the sixteenth century. The Gough map has additional secondary roads in South Yorkshire and Lincolnshire which suggests that this, the only surviving copy, was used in those parts.

The facsimile and memoir are admirable and should be acquired by every library and student of the subject. A.D.

Weltatlas; Die Staaten der Erde und ihre Wirtschaft. By Verlag Enzyklopädie Leipzig. 13½×10½. 105 Maps. Pp.57 (text). Leipzig, 1957. 24 DM.

An atlas providing up-to-date economic material such this one does, is always welcome in a world which has altered, not only politically, but also materially, during the the past two decades. The modern state of economic distributions is shown here firstly by a series of world maps and secondly, by maps of continents and their constituent countries.

So far as Europe is concerned each country is quite well treated. Prominence is perhaps naturally given to Germany, where, in addition to national maps, five regional maps and a special map of the Ruhr are included. Generally other countries are given only one page each though one has to look under "Nordeuropa" to find Denmark, Sweden, Norway or Finland. Beyond Europe, other continents and countries are less well treated. Africa is given least space, being entirely confined to one page.

Within the atlas, the arrangement of maps is good. On facing pages the reader sees, on the one hand, a physical topographic map of the the area and on the other, the complementary 'economic' map. The scales of several of these maps are however in many cases, too small. Many of the economic maps are overburdened with symbols which as a result tend to become indistinct or difficult to read. In several instances inset maps would have overcome this. The symbols, themselves, in several colours, are well devised and the same basic set is used throughout the atlas.

A brief glossary and an index are included at the end of the book. The atlas fills the gap created by recent change in conditions all over the world but one might have expected, from German atlas makers, more care in selecting scales and areas for detailed treatment in order to show the modern position more clearly.

I.A.G.K.

Map of Chomolongma - Mount Everest, 1:25,000 issued with Jahrbuch des Österreichischen Alpenvereins, 39×31½, 1957.

Everyone familiar with 'alpine' styles of cartography will welcome this extension of these techniques to the difficult task of mapping Everest. This excellent four-colour map on a scale of 1:25,000 offers a detailed picture of the country surrounding Mount Everest. Details of topography are carefully and scientifically drawn from ground and air survey and by their skillful blending yield a map of great beauty. Relief in such an area attracts most attention and the map incorporates several techniques of portrayal. Contours (20 m. interval), spot heights, hill shading and rock drawing combine to provide an accurate, visual representation of the surface of ground and ice. The techniques employed are almost wholly satisfactory and the three-dimensional illusion is well sustained. One might have thought that, where large areas of rock drawing are found, black is an over-obscuring colour and it is difficult at times to pick out spot heights for example. Surface features are represented in great detail and it is possible to pick out individual rock faces, ridges, scree, moraines etc., without difficulty. The details of settlement and vegetation are included where they occur with a similar regard to accuracy so that it is possible easily to pick out individual houses, stone walls and chortens.

The map has been made possible by a splendid piece of co-operation between the Österreichischen Alpenverein, Deutschen Alpenverein and Deutsche Forschungsgemeinschaft who are joint editors and who promoted and financed various aspects of the work. The Technische Hochschule of Munich is responsible for photogrametrical work while triangulation was conducted by the International Himalayan Expedition of 1955, trigonometrical details being supplied by the Survey of India. The well-known map-making house of Freytag-Berndt und Artaria of Vienna is responsible for printing and publishing. The map has value on many counts — it offers a detailed picture of a little known and difficult piece of country, it shows classical, geomorphological features by a visual means of relief but perhaps most significant, it shows a spirited answer to a challenge.

Recent years have brought forth several examples of skillful mapping of difficult ground such as the splendid Mount Kenya sheet of the Directorate of Overseas Survey and the 1:10,000 Mont Blanc series by French map-makers. Alpine cartographers have long been noted for the brilliant way in which they overcome the difficult terrain with which they are faced and it is fitting that Austrian and German mountaineers backed by modern methods of surveying have carried these techniques to the most inaccessible heights in the world. There is no doubt that the challenge has been met. It might be hoped that our own Ordnance Survey with their early record of brilliance will be stimulated by this sheet to tackle our most difficult mountains with a similar spirit. One would imagine that, for instance, a six-inch map of the Cuillins of Skye in a style similar to that adopted in the maps of Mount Kenya, Mont Blanc and Mount Everest itself would be most desirable from many points of view. Such a map would prove

that our surveyors were among the best in the world as those responsible for the Mount Everest sheet have done. I. A. G. K.

Ordnance Survey One-Inch Tourist Series: Lake District (Revised Edition). 32 x 40. Ordnance Survey, Chessington, 1958. Paper flat 4s, folded 6s, mounted and folded 8s 6d.

This new edition of the Lake District Tourist Map is a worthy successor to former editions covering this important tourist area. The novel treatment of the relief is the interesting feature of this edition and the one which merits most comment. The hill-shading provides the eye-catcher which brings the map to life and this effect is obtained by the modest use of two colours, buff and warm grey, on the illuminated and shaded sides respectively. At the same time land below 500 feet is in a pleasing pale green.

The result is a distinct improvement on the hill-shading of the recent O.S. quarter-inch sheet of North Wales, but is is suggested that fuller integration with layer-colouring as employed in the new Peak District map (in the same series) could have produced a still more effective result. Likewise, the deepest shadow tint might with advantage have been reserved for the steepest shadow slopes which are now only discernible after close inspection of the contours.

The place-names have the usual clarity of the *Seventh Series* from which the map is derived, but they also suffer the same flatness of character. These minor criticisms can be regarded as matters of opinion, and in no way suggest that this is anything but a most welcome and valuable map. J. B. C.

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

PROCEEDINGS

A MEETING OF COUNCIL was held on 13th January, 1959

OBITUARY: The Council regrets to announce the death of Dr William McCombie Alexander of Aberdeen, who for many years was a valuable member of the Place Names of Scotland Committee.

LECTURE SESSION 1958-59

The following lectures were delivered: —

EDINBURGH: *Usher Hall* - Roger Akester, M.A., Vet.M.B., M.R.C.V.S., on "Tibesti-Land of the Tebou", 15th January. Brigadier Sir John Hunt, C.B.E., D.S.O., on "The Caucasus Expedition, 1958", 12th February. Lady Wheeler on "The Walls of Jericho", 12th March. *Central Hall.* - Miss Kathleen MacIver, M.A., Ph.D., on "Tanganyika-Present Day Problems", 21st January. Richard H. Osborne, B.Sc., Ph.D., on "The Changing Face of Eastern Europe", 4th February. Arthur R. Wannop, O.B.E., F.R.S.E., on "New Zealand Journey", 11th February. Patrick Barnes, C.A., F.R.G.S., on "Round The Caribbean", 4th March. Miss Anna M. Scarlett on "Observations on a Trip to the Far East", 18th March.

GLASGOW: *St Andrews (Grand) Hall.* - Roger Akester, M.A., Vet., M.B., M.R.C.V.S., on "Tibesti-Land of the Tebou", 14th January. Brigadier Sir John Hunt, C.B.E., D.S.O., on "The Caucasus Expedition, 1958", 11th February. Lady Wheeler on "The Walls of Jericho", 13th March.. *St Andrews (Berkeley) Hall.* - Miss Kathleen MacIver, M.A., Ph.D., on "Tanganyika-Present Day Problems", 22th January. Arthur R. Wannop, O.B.E., F.R.S.E., on "New Zealand Journey", 19 th February. Patrick Barnes, C.A., F.R.G.S. on "Round the Carribbean", 5th April. *The Burlington Restaurant.* - Lecture Lunch - The Right Hon. Lord Belhaven and Stenton, F.R.E.S., F.R.C.A.S.

ABERDEEN: *Y.M.C.A. Hall.* - Roger Akester, M.A., Vet.M.B., M.R.C.V.S., on "Tibesti-Land of the Tebou", 12th January. Arthur R. Wannop, O.B.E., F.R.S.E., on "New Zealand Journey", 9th February. Patrick Barnes, C.A., F.R.G.S., on "Round the Carribbean", 9th March.

DUNDEE: *Queens College Hall.* - Roger Akester M.A., Vet.M.B., M.R.C.V.S., on "Tibesti-Land of the Tebou", 13th January. Arthur R. Wannop, O.B.E., F.R.S.E., on "New Zealand Journey", 10th February. Patrick Barnes, C.A., F.R.G.S., on "Round the Carribbean", 10th March.